



**Battles Elementary School
Santa Maria-Bonita School District
Santa Maria, California**

New TK/K Building and Site Upgrades

Project Manual

DLR Group Project No. 75-24119-00

**Construction Documents
DSA Submittal
December 16, 2024**

**DSA File #: 42-48
DSA App. #: 03 - 124614**

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BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
DECEMBER 16, 2024
CONSTRUCTION DOCUMENTS

SECTION 00 01 01
PROJECT TITLE PAGE

PROJECT MANUAL

FOR

BATTLES ES - TK-K BUILDING AND SITE UPGRADES

SANTA MARIA-BONITA SCHOOL DISTRICT
708 S. Miller Street, Santa Maria, CA 93454
805.361.8256
smbds.net

BATTLES ELEMENTARY SCHOOL
605 E. BATTLES ROAD
SANTA MARIA, CALIFORNIA 93454

PREPARED BY:

DLR GROUP
700 South Flower Street, 22nd Floor, Los Angeles CA 90017
213.514.9432
www.dlrgroup.com
Architect's Project Number: 75-24119-00.

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END OF SECTION

SECTION 00 01 02
PROJECT INFORMATION

PART 1 GENERAL

1.01 PROJECT IDENTIFICATION

- A. Architect's Project Number: 75-24119-00.
Battles Elementary School.
605 E. Battles Road.
Santa Maria, California 93454.
- B. The Owner, hereinafter referred to as District:
Santa Maria-Bonita School District
708 S. Miller Street, Santa Maria, CA 93454
smbsd.net
805.361.8256

1.02 NOTICE TO PROSPECTIVE BIDDERS

- A. These documents constitute an Invitation to Bid to and request for qualifications from General Contractors for the construction of the project described below.

1.03 PROJECT CONSULTANTS

- A. The Architect, hereinafter referred to as Architect: **DLR Group**
700 South Flower Street, 22nd Floor, Los Angeles CA 90017
www.dlrgroup.com
213.514.9432

1.04 PROCUREMENT TIMETABLE

- A. Last Request for Substitution Due: To be stated in bid documents.
- B. Last Request for Information Due: To be stated in bid documents.
- C. Contract Time: To be stated in bid documents.
- D. The District reserves the right to change the schedule or terminate the entire procurement process at any time.

1.05 PROCUREMENT DOCUMENTS

- A. Availability of Documents: Complete sets of procurement documents may be obtained:
 - 1. From District at the Project Manager's address listed above.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 00 01 0
SEALS PAGE

ARCHITECT OF RECORD (AOR)

DLR GROUP

700 South Flower Street, 22nd Floor, Los Angeles CA 90017



STRUCTURAL ENGINEER OF RECORD (SEOR)

DLR GROUP

700 South Flower Street, 22nd Floor, Los Angeles CA 90017



MECHANICAL PLUMBING ENGINEER OF RECORD (MEOR)

DLR GROUP

700 South Flower Street, 22nd Floor, Los Angeles CA 90017



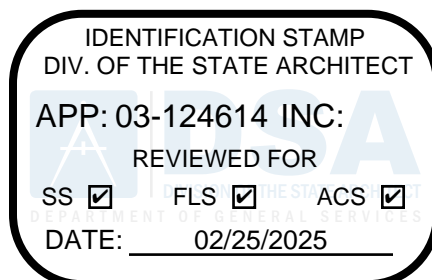
ELECTRICAL ENGINEER OF RECORD (EEOR)

DLR GROUP

700 South Flower Street, 22nd Floor, Los Angeles CA 90017



9/3/2024



FIRE PROTECTION ENGINEER OF RECORD (FPOR)

PROTECTIO DESIGN & CONSULTING

2851 Camino Del Rio, Suite 210, San Diego, CA 92108

Jonathon S. Mitcehell

FP-1559



CIVIL ENGINEER OF RECORD (CEOR)

KIMLEY-HORN

1100 W Town and Country Road, Suite 700, Orange, CA 92868



LANDSCAPE ARCHITECT OF RECORD (LAOR)

OASIS ASSOCIATES, INC.

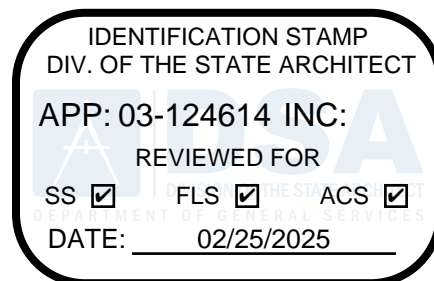
3427 Miguelito Court, San Luis Obispo, CA 93401

Michael Cripe

LA-2248



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BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA
32 92 00 - Turf Sodding

DLR GROUP: 75-24119-00
DECEMBER 16, 2024
CONSTRUCTION DOCUMENTS

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PART 1 GENERAL

1.01 EXISTING CONDITIONS

- A. Certain information relating to existing surface and subsurface conditions and structures is available to bidders but will not be part of Contract Documents, as follows:
- B. Geotechnical Report: Soils Engineering Report, New Tk/K Building And Site Improvements, Battles Elementary School, 605 East Battles Road, Santa Maria, California by GeoSolutions, Inc. Project GS00433-1, dated June 11, 2024.
 - 1. Geologic Hazard Assessment, GeoSolutions, Inc. Project GS00433-2, dated August 29, 2024.
 - 2. RFI No. 1 - Concrete Drive Aisles, Recommendations for Concrete Drive Aisles by GeoSolutions, Inc. Project GS00433-1, dated July 23, 2024.
 - 3. RFI No. 2 - Pier Footings, Recommendations for Cast-In-Place Drilled Pier Footings by GeoSolutions, Inc. Project GS00433-1, dated July 23, 2024.
 - 4. This report identifies properties of below grade conditions and offers recommendations for the design of foundations, prepared primarily for the use of Architect.
 - a. Soil and subsurface investigations conducted at site by an independent testing laboratory and report with log of borings prepared.
 - 5. Interpretation:
 - a. The District, Architect and Engineers disclaim all responsibility for the accuracy of information prepared by others.
 - 1) The District, Architect and Engineers disclaim all responsibility for the information to be completely representative of conditions and materials which may be encountered and as being adequate for the purposes of construction.
 - 2) Variations in kind, depth, quantity, and condition of soils may occur.
 - 3) The District, Architect and Engineers further disclaim responsibility for interpretation by Bidding Contractors and others of soil and subsurface investigation information, such as in projecting soil-bearing values, rock profiles, presence and scope of boulders and cobbles, soil stability and the presence, level and extent of underground water.
 - 6. The recommendations described shall not be construed as a requirement of this Contract, unless specifically referenced in Contract Documents.
 - 7. This report, by its nature, cannot reveal all conditions that exist on the site. Should subsurface conditions be found to vary substantially from this report, changes in the design and construction of foundations will be made, with resulting credits or expenditures to the Contract Sum accruing to District.
 - a. If variances from Geotechnical Report are found, make written report to Construction Manager.
 - b. Claims for conditions found to be not as indicated in soil investigation data not permitted, unless otherwise indicated in District-Contractor Agreement.

- 1) This applies only to conditions found after execution of the Agreement to be materially different from those reported and which are not customarily encountered in the geographic area.

1.02 BIDDER'S INVESTIGATIONS

- A. Bidder's Investigation: Bidder shall visit site and become familiar with site conditions.
 1. Bidder may, at Bidder's own expense and prior to bidding, make soil surveys and investigations Bidder considers necessary.
 2. Bidder assumes risk that soil and underground conditions may be other than that indicated in soil investigation data.
- B. Procedures:
 1. Obtain authorization from Construction Manager prior to start of borings or subsurface investigations.
 2. Immediately upon completion of Bidder's subsurface investigation, return site areas affected by investigations to condition existing prior to start of Bidder subsurface investigations as directed by Construction Manager.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

SECTION 00 40 25
REQUEST FOR INFORMATION

RFI NUMBER: _____ **DATE:** _____

PROJECT NAME: BATTLES ES - TK-K BUILDING AND SITE UPGRADES **PROJECT NO.: 75-24119-000**

TO: DLR GROUP

. 700 South Flower Street, 22nd Floor, Los Angeles CA 90017

Attention: _____

Contractor: _____

Address: _____

Request By: _____ Date: _____

BRIEF SUMMARY OF RFI: _____

Drawing No. _____ Detail No. _____

Specification Section _____ Title _____

.Page _____ Paragraph _____

DETAILS OF THIS RFI: _____

Attachments: _____

RESPONSE WILL BE INCLUDED IN AN ADDENDUM

END OF RFI

SECTION 00 43 25
SUBSTITUTION REQUEST FORM - DURING PROCUREMENT

SUBSTITUTION REQUEST NO. _____

DATE: _____

PROJECT NAME: **BATTLES ES - TK-K BUILDING AND SITE UPGRADES**

PROJECT NUMBER: **75-24119-000**

TO: **DLR GROUP**

. 700 South Flower Street, 22nd Floor, Los Angeles CA 90017

From: _____

We hereby submit for your consideration the following product comparisons of the specified product and the proposed substitution. The undersigned fully understands that failure to answer any item below may be cause for rejection of request for substitution.

Request for substitution shall only be made during bidding (not later than 7 days prior to bid opening for inclusion by Addendum) except under conditions beyond control of Contractor.

SPECIFIED PRODUCT:

Project Manual Section Title _____ Number ____ Page ____ Paragraph ____.

Drawing No. _____ Detail No. _____

Proposed Substitution: _____

Manufacturer: _____ Tel: _____

A. Is the point-by-point comparative data attached? — REQUIRED BY A/E

B. Reason request for substitution is being submitted: _____

DIFFERENCES BETWEEN PROPOSED SUBSTITUTION AND SPECIFIED PRODUCT

C. Does proposed substitution affect in any way the Structural Safety, Access Compliance, or Fire & Life Safety portions of the project? No__ Yes__

Explain _____

D. Does proposed substitution affect dimensions, gages, weights, etc. on Drawing? No__ Yes__

Explain _____

- E. Does proposed substitution require changes in Drawings or design and installation changes?
No___ Yes___
_____ (If yes, cost of these changes is the responsibility of the Contractor.)
- F. Does proposed substitution affect product cost, delivery time, or construction schedule?
No___ Yes___ Explain _____
- G. Does proposed substitution comply with specified ICC Number, UL Rating, ASTM Numbers?
No___ Yes___ Explain _____
- H. Does proposed substitution affect other trades and systems such as wiring, piping, ductwork, structure, etc.? No___ Yes___ (Explain which and how) _____

- I. Does proposed substitution product guarantee differ from that of the specified product? No___ Yes___ Explain _____

Attach a listing of 3 similar projects (one in service for at least 3 years) using the proposed substitution.

Substantiating Data: Attach product data/brochures and Vendor qualifications for both specified and substitute product. Provide samples for both specified and substitute products, if applicable.

Certification: Undersigned has examined Construction Documents, is familiar with specified product, understands indicated application of product, and understands design intent of the Architect caused by the requested substitution.

Submitted by: _____

_____. (Type Name) Signature Date

Signature must be made by person having legal authority to bind his firm to the above terms.

END OF SECTION

SECTION 00 63 25
SUBSTITUTION REQUEST FORM - DURING CONSTRUCTION

SUBSTITUTION REQUEST NO. _____

DATE: _____

PROJECT NAME: BATTLES ES - TK-K BUILDING AND SITE UPGRADES

PROJECT NUMBER: 75-24119-000

TO: DLR GROUP

. 700 South Flower Street, 22nd Floor, Los Angeles CA 90017

From: _____

We hereby submit for your consideration the following product comparisons of the specified product and the proposed substitution. The undersigned fully understands that failure to answer any item below may be cause for rejection of request for substitution.

This request for substitution form shall only be used after the end of the bidding period except under conditions beyond control of Contractor.

Specified Product: _____

Project Manual Section Title _____ **Number** ____ **Page** ____ **Paragraph** ____.

Drawing No. _____ **Detail No.** _____

Proposed Substitution: _____

Manufacturer: _____ **Tel:** _____

A. Reason request for substitution is being submitted: _____

B. Does proposed substitution affect in any way the Structural Safety, Access Compliance, or Fire & Life Safety portions of the project? No__ Yes__

Explain _____

C. Does proposed substitution affect dimensions, gages, weights, etc. on Drawing? No__ Yes__

Explain _____

D. Does proposed substitution require changes in Drawings or design and installation changes?
No__ Yes__

(If yes, cost of Architect and Engineer document changes are the responsibility of the Contractor.)

- E. Does proposed substitution affect product cost, delivery time, or construction schedule?
No ___ Yes ___ Explain _____
- F. Does proposed substitution comply with specified ICC Number, UL Rating, ASTM Numbers?
No ___ Yes ___ Explain _____
- G. Does proposed substitution affect other trades and systems such as wiring, piping, ductwork, structure, etc.? No ___ Yes ___ (Explain which and how) _____

If yes, has impact on their work been included in price of proposed substitution? No ___ Yes ___.

- H. Does proposed substitution product guarantee differ from that of the specified product? No ___ Yes ___ Explain _____

If the substitution request is accepted, it will result in:

No cost impact ___ Improve Schedule ___ Credit of \$ _____

Attach a listing of 3 projects (one in service for at least 3 years) using the proposed substitution.

Substantiating Data: Attach product data/brochures and Vendor qualifications for both specified and substitute product. Provide samples for both specified and substitute products, if applicable.

Certification: Undersigned has examined Construction Documents, is familiar with specified product, understands indicated application of product, and understands design intent of the Architect caused by the requested substitution.

Submitted by: _____

_____. (Type Name) Signature Date

Signature must be made by person having legal authority to bind his firm to the above terms.

Architect's Comments:

_____ Accepted, _____ accepted as noted, _____ not accepted, _____ received too late.

Reviewed by:

Architect Date

DSA Date

District Date

END OF SECTION

SECTION 01 10 00 SUMMARY

PART 1 GENERAL

1.01 PROJECT

- A. Project Name: Battles ES - TK-K Building and Site Upgrades
- B. District's Name: Santa Maria-Bonita School District.
- C. Architect's Name: DLR Group.
- D. The Project consists of the construction of new building on an existing school campus located at Battles Elementary School.

1.02 CONTRACT DESCRIPTION

- A. Contract Type: A single prime contract based on a Stipulated Price as described in Owner-Contractor Agreement.
- B. The Work is construction and related services for a , CBC, Occupancy Type Educational Group E, Construction Type V-B, , totaling approximately 10,870 square feet.
 - 1. The Work includes new building construction, interior improvements, building utilities, and related site improvements; with patch and repair as required, and other features to the extent indicated on the Drawings.
 - 2. Hazardous Material Abatement is specified in a separate document prepared by the District's Consultant and is not managed by the Architect or the Architect's Consultants.

1.03 CONTRACT DOCUMENTS

- A. Contract Requirements:
 - 1. Conditions of the Contract and other Contract documents have been included in the Project Manual, as indicated in the Table of Contents.
 - a. Such documents are not Specifications.
 - 2. Specifications are found in the technical Divisions of the Project Manual.
- B. Contract Drawings: The Drawings provided with and identified in the Project Manual are the Drawings referenced in the Agreement.
 - 1. The location, extent and configuration of the required construction and improvements are shown and noted on Drawings.
 - a. The Drawings are referenced in the Agreement.
 - b. An index of Drawings is included in the set of Drawings.
 - 2. Drawings are arranged into series according to design discipline. Such organization and all references to trades, subcontractor, specialty contractor or supplier shall not control the Contractor in dividing the Work among subcontractors or in establishing the extent of the Work to be performed by any trade.
 - 3. Where the terms "as shown", "as indicated", "as noted", "as detailed", "as scheduled", or terms of like meaning, are used in the Drawings or Specifications, it shall be understood that reference is being made to the Drawings referenced in the Agreement.

4. Where reference to the word "plans" is made anywhere in Drawings, Specifications and related Contract Documents, it shall be understood to mean the Drawings referenced in the Agreement.
- C. Contract Specifications: The Specifications provided in the Project Manual are the Specifications referenced in the Agreement.
 1. Specifications are organized by Divisions and Sections in accordance with the recommended practices of the Construction Specifications Institute.
 - a. Such organization shall not control the Contractor in dividing the Work among subcontractors or in establishing the extent of Work to be performed by any trade.
 2. Specifications are included in the Project Manual, which may also include other Bidding and Contract Documents.
 - a. Contents of the Project Manual are listed in Document 00 01 10 - Table of Contents, in the Project Manual.

1.04 WORK BY OWNER

- A. Concurrent Work Under Separate Contracts:
 1. Work Under Separate Contracts: District will award separate contracts for products and installation for interior improvements and other work as may be indicated on Drawings as NIC (Not in Contract).
 2. Relationship to Work Under the Contract:
 - a. Work under the Contract shall include all provisions necessary to make such concurrent work under separate contracts complete in every respect and fully functional, including field finishing.
 - b. Provide necessary backing, supports, piping, conduit, conductors and other such provisions from point of service to point of connection, as shown on Drawings and specified herein.
 3. Related Contract Documents:
 - a. District will make available, in a timely manner, drawings and specifications of work under separate contracts for coordination and further description of that work.
 - b. Such drawings and other data required for the coordination of the work of separate contracts with the Work of this Contract may be included with the Contract Documents.
 - c. If so, they are provided for convenience only and are not to be considered Contract Documents produced by Architect or Architect's consultants.
 4. Permits, Notices and Fees:
 - a. Permits, Notices and Fees: Notices required by and approvals required of authorities having jurisdiction for work under separate contracts and related fees will be solely the responsibility of District.
- B. Items noted NIC (Not in Contract) will be supplied and installed by District before Date of Final Inspection. Some items include:
 1. Movable cabinets.
 2. Furnishings.
 3. Small equipment.
 4. Rugs.

5. Artwork.
- C. OFOI - District will supply and install the following:
 1. Hand sanitizers.
- D. OFCI - District will supply the following for installation by Contractor:
 1. District may furnish, for installation by Contractor, products which are identified on the Drawings and in the Specifications as OFCI (Owner-Furnished/Contractor-Installed).
 - a. Paper towel dispensers.
 - b. Soap dispensers.
 2. Relationship to Work Under the Contract:
 - a. Work under the Contract shall include all provisions necessary to fully incorporate such products into the Work, including, as necessary.
 - 1) Fasteners.
 - 2) Backing,.
 - 3) Supports.
 - 4) Piping.
 - 5) Conduit.
 - 6) Conductors.
 - 7) Other such provisions from point of service to point of connection, for a complete installation.
 - 8) Field finishing, as shown on Drawings and specified herein.
 - b. See Section 01 30 00 - Administrative Requirements for additional requirements.

1.05 PERMITS, LICENSES AND FEES

- A. Permits:
 1. For Work included in the Contract, Contractor shall obtain all permits from authorities having jurisdiction and from serving utility companies and agencies.
 2. District will reimburse Contractor for amount charged for such permits, without mark-up.
 3. For Work performed under design/build basis, plan check and permit fees shall be included in the Contract Sum.
- B. Licenses:
 1. Contractor shall obtain and pay all licenses associated with construction activities, such as business licenses, contractors' licenses and vehicle and equipment licenses.
 2. All costs for licenses shall be included in the Contract Sum.
- C. Assessments:
 1. District will pay all assessments and utility service connection fees. Costs of assessments shall not be included in the Contract Sum.
- D. Test and Inspection Fees:
 1. Contractor shall pay all fees charged by authorities having jurisdiction and from serving utility companies and agencies, for tests and inspections conducted by those authorities, companies and agencies.
 2. District will reimburse Contractor for actual amount of such fees, without mark-up.

3. Refer to Section 01 40 00 - Quality Requirements for additional information on tests and inspections and responsibility for payment of fees.

1.06 OWNER OCCUPANCY

- A. District intends to continue to occupy adjacent portions of the existing site during the entire construction period.
- B. District intends to occupy the Project by the date stated in the Agreement as the contract completion date.
- C. Cooperate with District to minimize conflict and to facilitate District's operations.
- D. Schedule the Work to accommodate District occupancy.

1.07 CONTRACTOR USE OF SITE AND PREMISES

- A. Construction Operations: Limited to areas noted on Drawings.
- B. Arrange use of site and premises to allow:
 1. District occupancy.
 2. Work by Others.
 3. Work by District.
 4. Use of site and premises by the public.
- C. Provide access to and from site as required by law and by District:
 1. Emergency Building Exits During Construction: Keep all exits required by code open during construction period; provide temporary exit signs if exit routes are temporarily altered.
 2. Site Access:
 - a. Limit access to site to indicated routes and access points as indicated.
 - b. If routes and access points are not indicated, access shall be as approved by District.
 - c. Do not restrict access to adjacent properties and do not restrict access for those performing work under separate contracts for the District.
 3. Do not obstruct roadways, sidewalks, or other public ways without permit.
 4. Construction Limit:
 - a. Limit construction activities to areas indicated on Drawings as Project Area or, if not indicated, to areas within the parcel as described in the legal description on the Drawings.
 - b. Refer also to Section 01 50 00 - Temporary Construction Facilities and Controls for additional requirements.
- D. Existing building spaces may not be used for storage.
- E. Time Restrictions:
 1. Limit conduct of especially noisy malodorous and dusty exterior work to the hours of 8 AM to 6 PM.
- F. Utility Outages and Shutdown:
 1. Limit disruption of utility services to hours the site is unoccupied.
 2. Do not disrupt or shut down life safety systems, including but not limited to fire sprinklers and fire alarm system, without 7 days notice to District and authorities having jurisdiction.

3. Prevent accidental disruption of utility services to other facilities.

1.08 CONSTRUCTION WASTE MANAGEMENT

- A. Construction and waste management, complying with Section 01 74 19 - Construction Waste Management and Disposal, is a requirement for this project.
- B. The Contractor, Prime Contractors, and subcontractors all have obligations in meeting the requirements of this specification.

END OF SECTION

SECTION 01 20 00 PRICE AND PAYMENT PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedures for preparation and submittal of applications for progress payments.
- B. Documentation of changes in Contract Sum and Contract Time.
- C. Change procedures.
- D. Correlation of Contractor submittals based on changes.
- E. Procedures for preparation and submittal of application for final payment.

1.02 RELATED REQUIREMENTS

- A. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 SCHEDULE OF VALUES

- A. Use Schedule of Values Form: Form provided by District.
- B. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit draft to Architect for approval.
- C. Submit Schedule of Values in duplicate within 15 days after date established in Notice to Proceed.
 - 1. Submit schedule in a spreadsheet calculated format, such as Excel, based upon the attached Schedule of Values augmented by the Table of Contents of this Project Manual.
- D. Format: Utilize the Table of Contents of this Project Manual. Identify each line item with number and title of the major specification section. Identify site mobilization, bonds and insurance, and record drawings .
- E. Where work is separated into phases requiring separately phased payments, provide separate schedule for each phase.
- F. Where work involves multiple sites and/or "A" number, provide separate schedules for each site and/or "A" number.
- G. Where scope of work involves multiples buildings/structures, provide separate schedule for each building.
- H. Include in each line item, the amount of Allowances specified in this section.
- I. Include separately from each line item, a direct proportional amount of Contractor's overhead and profit.
- J. Revise schedule to list approved Change Orders, with each Application For Payment.
 - 1. List each authorized Change Order as an extension on the continuation sheet, listing the Change Order number and dollar value as for an original portion of Work.

1.04 APPLICATIONS FOR PROGRESS PAYMENTS

- A. Payment Period: Submit at intervals stipulated in the Agreement.
 - 1. Substantiating information will normally be required only for those portions of Work whose completion state cannot be readily determined by observation of the completed Work.

- B. Use Form Form as provided by District.
- C. Electronic media printout including equivalent information will be considered in lieu of standard form specified; submit sample to Architect for approval.
- D. Forms filled out by hand will not be accepted.
- E. For each item, provide a column for listing each of the following:
 - 1. Item Number.
 - 2. Description of work.
 - 3. Scheduled Values.
 - 4. Previous Applications.
 - 5. Work in Place and Stored Materials under this Application.
 - 6. Authorized Change Orders.
 - 7. Total Completed and Stored to Date of Application.
 - 8. Balance to Finish.
 - 9. Retainage.
- F. Execute certification by signature of authorized officer.
- G. Use data from approved Schedule of Values. Provide dollar value in each column for each line item for portion of work performed and for stored products.
- H. List each authorized Change Order as a separate line item, listing Change Order number and dollar amount as for an original item of work.
 - 1. No Change Orders shall be included with Application for Payment until approved in writing by District and Architect. Also approved by DSA when appropriate.
- I. Submit one electronic and three hard-copies of each Application for Payment.
- J. Include the following with the application:
 - 1. Transmittal letter as specified for submittals in Section 01 30 00.
 - 2. Construction progress schedule, revised and current as specified in Section 01 32 16.
 - 3. Current construction photographs specified in Section 01 30 00.
 - 4. Partial release of liens from major subcontractors and vendors.
 - a. Provide with each Application for Payment lien releases from all subcontractors, workers and materials suppliers employed for the Project covering their portion of Work to date for which payment application is made. Lien release forms will be provided by District and shall be completed in accordance with directions provided.
 - 5. Project record documents as specified in Section 01 78 00, for review by District which will be returned to the Contractor.
 - 6. Affidavits attesting to off-site stored products.
- K. When Architect requires substantiating information, submit data justifying dollar amounts in question. Provide one copy of data with cover letter for each copy of submittal. Show application number and date, and line item by number and description.

1.05 ADDENDA

- A. Addenda are changes issued prior to the signing of the Contract for Construction. These Addenda shall be signed by the Architect and approved by the Division of the State Architect per CAC Sec 4-338(b).

- B. These documents may or may not have approved by the Division of the State Architect prior to the close of Bid.
 - 1. If not approved by DSA prior to close of the bidding period, the contract price shall include the Addenda.
 - 2. No work shall proceed regarding any Addendum until approved by DSA.
 - 3. Revisions to Addenda, when approved by DSA, shall be incorporated by an additional addendum or Change Order as indicated below and as provided for in the Contract for Construction and General Conditions.

1.06 MODIFICATION PROCEDURES

- A. Construction Changes, General:
 - 1. The following describe administrative procedures to be followed in compliance with provisions of the Conditions of the Contract for Architect's Supplemental Instructions, Construction Change Directives, Construction Change Documents, and Contract Change Orders.
 - 2. The Architect will prepare and issue: Architect's Supplemental Instructions, a Construction Change Directive or a Request for Proposal to be presented to the Contractor for action.
- B. Submit name of the individual authorized to receive change documents and who will be responsible for informing others in Contractor's employ or subcontractors of changes to Contract Documents.
- C. Contract Change Order Forms: Form as directed by District.
- D. For minor changes not involving an adjustment to the Contract Sum or Contract Time, Architect will issue instructions directly to Contractor.
 - 1. Architect's Supplemental Instructions:
 - a. Minor changes in the Work, not involving an adjustment in either the Contract Sum or Contract Time, as authorized by the Conditions of the Contract, will be presented by the Architect using the Architect's Bulletin form.
 - b. Should the Architect's Supplemental Instructions result in disputed costs and time adjustments, such dispute shall be resolved in accordance with the provisions of the Conditions of the Contract.
- E. DSA Construction Change Document approval for substitutions and changes to structural, accessibility, or fire-life-safety portions of approved Drawings and Specifications is required from DSA prior to fabrication and installation. DSA IR A-6; CAC Section 4-215, & 4-233(c).
 - 1. The approved Construction Change Document shall be signed by:
 - a. Architect of Record.
 - b. When applicable:
 - 1) Structural Engineer of Record.
 - 2) Mechanical Engineer of Record.
 - 3) Electrical Engineer of Record.
 - 4) Civil Engineer of Record.
 - 5) Delegated Professional Engineer.
 - c. Division of the State Architect for final approval.

- F. For other required changes, not involving structural, accessibility, or fire-life-safety portions of approved Drawings and Specifications, Architect will issue a document signed by District instructing Contractor to proceed with the change, for subsequent inclusion in a Change Order.
1. The document will describe the required changes and will designate method of determining any change in Contract Sum or Contract Time.
 2. Promptly execute the change.
 3. Construction Change Directive approval is required from DSA prior to installation.
 4. Construction Change Directives: In accordance with provisions of the Conditions of the Contract, the District may direct the Contractor to proceed with a change in the Work prior to formal preparation, review and agreement of a Contract Change Order, in order to not delay construction.
 - a. The Architect will prepare and issue a change document containing a Construction Change Directive which, when signed by the District and the Architect, shall instruct the Contractor to proceed with a change in the Work, for subsequent inclusion in a Contract Change Order.
 - b. Should the Construction Change Directive result in disputed costs and time adjustments, such dispute shall be resolved in accordance with the provisions of the Conditions of the Contract.
 - c. Construction Change Directives shall follow procedures specified below for Contract Change Orders except that Contractor shall immediately proceed with the change upon receipt of the signed Change Directive.
- G. For changes for which advance pricing is desired, Architect will issue a document that includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change with a stipulation of any overtime work required and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a fixed price quotation within 14 days.
1. Such Request for Proposal may include an estimate of additions or deductions in Contract Time and Contract Sum for executing the change and may include stipulations regarding overtime work and the period of time the requested response from the Contractor shall be considered valid.
- H. Contractor may propose a change by submitting a request for change to Architect, describing the proposed change and its full effect on the work, with a statement describing the reason for the change, and the effect on the Contract Sum and Contract Time with full documentation and a statement describing the effect on work by separate or other contractors. Document any requested substitutions in accordance with Section 01 60 00 .
1. After review of the request and with the District's approval, the Architect will prepare a change document containing a Request for Proposal, as described above.
 2. Issuance of such a request by the Architect shall not indicate authorization of the Contractor to proceed with the proposed change.
 3. Changes will be approved only by an approved Construction Change Directive and Contract Change Order.
- I. Computation of Change in Contract Amount: As specified in the Agreement and Conditions of the Contract.
1. For change requested by Architect for work falling under a fixed price contract, the amount will be based on Contractor's price quotation.
 2. For change requested by Contractor, the amount will be based on the Contractor's request for a Change Order as approved by Architect.

3. For pre-determined unit prices and quantities, the amount will be based on the fixed unit prices.
 4. For change ordered by Architect without a quotation from Contractor, the amount will be determined by Architect based on the Contractor's substantiation of costs as specified for Time and Material work.
- J. Substantiation of Costs: Provide full information required for evaluation.
1. On request, provide the following data:
 - a. Quantities of products, labor, and equipment.
 - b. Taxes, insurance, and bonds.
 - c. Overhead and profit.
 - d. Justification for any change in Contract Time.
 - e. Credit for deletions from Contract, similarly documented.
 2. Support each claim for additional costs with additional information:
 - a. Origin and date of claim.
 - b. Dates and times work was performed, and by whom.
 - c. Time records and wage rates paid.
 - d. Invoices and receipts for products, equipment, and subcontracts, similarly documented.
 3. For Time and Material work, submit itemized account and supporting data after completion of change, within time limits indicated in the Conditions of the Contract.
 - a. Cost and Time Resolution: If amounts for changes in Contract Sum and Contract Time cannot be agreed upon by District and Contractor, amounts shall be resolved in accordance with provisions of the Conditions of the Contract for resolution of disputes and the following:
 - 1) Contractor shall keep accurate records of time, both labor and calendar days, and cost of materials and equipment.
 - 2) Contractor shall prepare and submit an itemized account and supporting data after completion of changed Work, within the time limits indicated in the Conditions of the Contract.
 - 3) Contractor shall provide full information as required and requested, for District and Architect to evaluate and substantiate proposed costs and time for the change in the Work.
 - 4) When District and Contractor determine mutually acceptable amounts for changes in Contract Sum and Contract Time, a Contract Change Order shall be executed for these amounts.
 - 5) District shall have the right to audit Contractor's invoices and bid quotations to substantiate costs for Contract Change Orders.
- K. Construction Changes Based on Stipulated Sum or Time: Based on the Contractor's response to a Request for Proposal or Construction Change Directive, the District and Architect will review the response.
1. The District and Contractor shall negotiate a mutually acceptable adjustment in Contract Sum and Contract Time, as appropriate, prior to performance of the changed Work.
 2. A Contract Change Order for the stipulated amounts shall be prepared based on the stipulated sum and change in time.

- L. Execution of Change Orders: Architect will issue Change Orders for signatures of parties as provided in the Conditions of the Contract.
 - 1. When agreement is reached on changes, if any, in the Contract Time and the Contract Sum, the Contractor shall prepare a Contract Change Order using a form as directed by the District, with supplementary documents as necessary to describe the change and the associated costs and schedule impacts.
 - 2. Construction Change Document approval is required from DSA prior to fabrication and installation.
 - 3. Submit Contract Change Orders to District through the Architect.
 - 4. Contractor shall prepare and submit five original sets of documents for each Change Order. District, Architect and DSA shall sign the Change Order indicating acceptance and approval of the change.
 - a. Structural Engineer shall also sign the Change Order, when applicable.
 - 5. All Change Orders must be approved by DSA prior to fabrication and installation.
 - 6. Upon approval of the Change Order, Contractor shall promptly execute the change in the Work.
- M. After execution of Change Order, promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item and adjust the Contract Sum.
- N. Promptly revise progress schedules to reflect any change in Contract Time, revise sub-schedules to adjust times for other items of work affected by the change, and resubmit.
 - 1. Contractor shall submit revised schedules at the next Application for Payment following approval and acceptance of the Contract Change Order.
- O. Promptly enter changes in Project Record Documents.

1.07 APPLICATION FOR FINAL PAYMENT

- A. Prepare Application for Final Payment as specified for progress payments, identifying total adjusted Contract Sum, previous payments, and sum remaining due.
- B. Application for Final Payment will not be considered until the following have been accomplished:
 - 1. All closeout procedures specified in Section 01 70 00.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 25 00 SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Procedural requirements for proposed substitutions.

1.02 RELATED REQUIREMENTS

- A. Division 00 - Procurement and Contracting Requirements: Restrictions on timing of substitution requests.
- B. Section 00 43 25 - Substitution Request Form - During Procurement: Required form for substitution requests made prior to award of contract (During procurement).
- C. Section 00 63 25 - Substitution Request Form - During Construction: Required form for substitution requests made after award of contract (During construction).
- D. Section 01 30 00 - Administrative Requirements: Submittal procedures, coordination.
- E. Section 01 60 00 - Product Requirements: Fundamental product requirements, product options, delivery, storage, and handling.
- F. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Restrictions on emissions of indoor substitute products.

1.03 DEFINITIONS

- A. Substitutions: Changes from Contract Documents requirements proposed by Contractor to materials, products, assemblies, and equipment.
 - 1. Substitutions for Cause: Proposed due to changed Project circumstances beyond Contractor's control.
 - a. Unavailability.
 - b. Regulatory changes.
 - 2. Substitutions for Convenience: Proposed due to possibility of offering substantial advantage to the Project.
 - a. Substitution requests offering advantages solely to the Contractor will not be considered.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 GENERAL REQUIREMENTS

- A. Requests by Contractor to deviate from specified requirements for products, materials, equipment, and methods, or to provide products other than those specified, shall be considered requests for substitutions except under the following conditions:
 - 1. Substitutions are requested during the bidding period, and accepted prior to execution of the Contract. Acceptance shall be in the form of written Addendum to the Bidding documents or revision to the Drawings or Specifications for use as Construction Contract Documents.

2. Changes in products, materials, equipment, and methods of construction are directed by the District or Architect.
 3. Contractor options for provision of products and construction methods are specifically stated in the Contract Documents.
 4. Change in products, materials, equipment, and methods of construction is required for compliance with Codes, ordinances, regulations, orders and standards of authorities having jurisdiction.
- B. Substitution Provisions: Refer to substitution provisions of the Conditions of the Contract, in addition to the requirements specified herein. Provisions for consideration and acceptance of substitutions shall be as follows:
1. Documentation:
 - a. Substitutions will not be considered if they are indicated or implied on shop drawing, product data or sample submittals.
 - b. All requests for substitution shall be made by separate written request from Contractor.
 2. Cost and Time Considerations: Substitutions will not be considered unless a net reduction in Contract Sum or Contract Time results to the District's benefit, including redesign costs, life cycle costs, changes in related Work and overall performance of building systems.
 3. Design Revision:
 - a. Substitutions will not be considered if acceptance will require substantial revision of the Contract Documents or will substantially change the intent of the design, in the opinion of the Architect.
 - b. The intent of the design shall include functional performance and aesthetic qualities.
 4. Data: It shall be the responsibility of the Contractor to provide adequate data demonstrating the merits of the proposed substitution, including cost data and information regarding changes in related Work.
 5. Determination by Architect:
 - a. Architect will determine the acceptability of proposed substitutions and will notify Contractor, in writing within a reasonable time, of acceptance or rejection.
 - b. The determination by the Architect regarding functional performance and aesthetic quality shall be final.
 6. Non-Acceptance: If a proposed substitution is not accepted, provide the specified product.
 - a. If, in the opinion of the Architect, the substitution request is incomplete or has insufficient data to enable a full and thorough review of the intended substitution, the substitution may be summarily refused and determined to be unacceptable.
 7. Substitution Limitation: Only one request for substitution will be considered for each product.
- C. A Substitution Request for products, assemblies, materials, and equipment constitutes a representation that the submitter:
1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product, equipment, assembly, or system.
 - a. Include a signed certification that the Contractor has:
 - 1) Reviewed the proposed substitution and has determined that the substitution is equivalent or superior in every respect to product requirements indicated or product specified in the Contract Documents.

- 2) Certify the proposed substitution is suited for and can perform the purpose or application of the specified product indicated or specified in the Contract Documents.
2. Agrees to provide the same warranty for the substitution as for the specified product.
3. Agrees to provide same or equivalent maintenance service and source of replacement parts, as applicable.
4. Agrees to coordinate installation and make changes to other work that may be required for the work to be complete, with no additional cost to District.
5. Waives claims for additional costs or time extension that may subsequently become apparent.
 - a. Include a signed waiver by the Contractor for changes in the Contract Time or Contract Sum because of the following:
 - 1) Substitution failed to perform adequately.
 - 2) Substitution required changes in on other elements of the Work.
 - 3) Substitution caused problems in interfacing with other elements of the Work.
 - 4) Substitution was determined to be unacceptable by authorities having jurisdiction.
6. Agrees to reimburse District and Architect for review or redesign services associated with re-approval by authorities.
- D. A Substitution Request for specified installer constitutes a representation that the submitter:
 1. Has acted in good faith to obtain services of specified installer, but was unable to come to commercial, or other terms.
- E. Document each request with complete data substantiating compliance of proposed substitution with Contract Documents. Burden of proof is on proposer.
 1. Note explicitly any non-compliant characteristics.
- F. Content: Include information necessary for tracking the status of each Substitution Request, and information necessary to provide an actionable response.
 1. Forms indicated and included in the Project Manual are adequate for this purpose, and must be used.
 2. No specific form is required. Contractor's Substitution Request documentation must include the following:
 - a. Project Information:
 - 1) Official project name and number, and any additional required identifiers established in Contract Documents.
 - 2) District's, Architect's, and Contractor's names.
 - b. Substitution Request Information:
 - 1) Discrete and consecutive Substitution Request number, and descriptive subject/title.
 - 2) Indication of whether the substitution is for cause or convenience.
 - 3) Issue date.
 - 4) Reference to particular Contract Document(s) specification section number, title, and article/paragraph(s).
 - 5) Description of Substitution.

- 6) Reason why the specified item cannot be provided.
 - 7) Differences between proposed substitution and specified item.
 - 8) Description of how proposed substitution affects other parts of work.
 - c. Attached Comparative Data: Provide point-by-point, side-by-side comparison addressing essential attributes specified, as appropriate and relevant for the item:
 - 1) Physical characteristics.
 - 2) In-service performance.
 - 3) Expected durability.
 - 4) Visual effect.
 - 5) Sustainable design features.
 - 6) Warranties.
 - 7) Other salient features and requirements.
 - 8) Include, as appropriate or requested, the following types of documentation:
 - (a) Product Data:
 - (b) Samples.
 - (c) Certificates, test, reports or similar qualification data.
 - (d) Drawings, when required to show impact on adjacent construction elements.
 - 9) Include a detailed description, in written or graphic form as appropriate, indicating all changes or modifications needed to other elements of the Work and to construction to be performed by the District and by others under separate Contract with District, that will be necessary if the proposed substitution is accepted.
 - d. Impact of Substitution:
 - 1) Savings to District for accepting substitution.
 - (a) Include detailed cost data, including a proposal for the net change, if any, in the Contract Sum.
 - 2) Change to Contract Time due to accepting substitution.
 - (a) Indicate the substitution's effect on the Construction Schedule. Indicate the effect of the proposed substitution on overall Contract Time and, as applicable, on completion of portions of the Work for use by District or for work under separate contract by District.
- G. Limit each request to a single proposed substitution item.
 1. Submit an electronic document, combining the request form with supporting data into single document.

3.02 SUBSTITUTION PROCEDURES DURING PROCUREMENT

- A. Submittal Time Restrictions:
 1. District will consider requests for substitutions only if submitted at least 10 days prior to the date for receipt of bids.
- B. Instructions to Bidders specifies time restrictions for submitting requests for substitutions during the bidding period, and the documents required.

- C. Pursuant to Section 3400 of the Public Contract Code, requests for substitution will be considered only if received up to 7 days prior to the bid date. Subsequent requests will be considered only in the case of product unavailability, through no fault of the Contractor, or for reasons of cost reducing value analysis requested by the District.
- D. Submittal Form (before award of contract):
 - 1. Submit substitution requests by completing the form in Section 00 43 25; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.

3.03 SUBSTITUTION PROCEDURES DURING CONSTRUCTION

- A. Submittal Form (after award of contract):
 - 1. Submit substitution requests by completing the form in Section 00 63 25; see this section for additional information and instructions. Use only this form; other forms of submission are unacceptable.
- B. After Contract award, requests will be considered for cause only; in the case of product unavailability, through no fault of the Contractor, or for reasons of cost reducing value analysis requested by the District.
 - 1. Substitutions will be considered when a product, through no fault of the Contractor, becomes unavailable or unsuitable due to regulatory change.
 - 2. Product Availability Waiver:
 - a. Substitutions will be considered after 35 day time limit only when a product becomes unavailable due to no fault of Contractor.
 - b. Failure to place orders for specified products sufficiently in advance of required date for incorporation into the Work will not be considered as a valid reason for which Contractor may request a substitution or deviation from requirements of the Drawings and Specifications.
 - 3. Waiver: At the discretion of the District, limitations on substitutions may be waived.
- C. Submit request for Substitution for Cause within 14 days of discovery of need for substitution, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
- D. Submit request for Substitution for Convenience immediately upon discovery of its potential advantage to the project, but not later than 14 days prior to time required for review and approval by Architect, in order to stay on approved project schedule.
 - 1. In addition to meeting general documentation requirements, document how the requested substitution benefits the District through cost savings, time savings, greater energy conservation, or in other specific ways.
 - 2. Document means of coordinating of substitution item with other portions of the work, including work by affected subcontractors.
 - 3. Bear the costs engendered by proposed substitution of:
 - a. District's compensation to the Architect for any required redesign, time spent processing and evaluating the request.
 - b. Other construction by District.
 - c. Other unanticipated project considerations.
- E. Substitutions will not be considered under one or more of the following circumstances:
 - 1. When they are indicated or implied on shop drawing or product data submittals, without having received prior approval.

2. Without a separate written request.
3. When acceptance will require revisions to Contract Documents.

3.04 CONTRACT DOCUMENT REVISIONS:

- A. Should a Contractor-proposed substitution or alternative sequence or method of construction require revision of the Contract Drawings or Specifications;
 1. Including revisions for the purposes of determining feasibility, scope or cost, or revisions for the purpose of obtaining review and approval by authorities having jurisdiction.
 2. Revisions will be made by Architect or other consultant of District who is the responsible design professional, as approved in advance by District.
- B. Services of Architect or other consultant of the District, including time spent in researching and reporting on proposed substitutions or alternative sequence and method of construction, shall be paid by Contractor when such activities are considered additional services to the design services contracts of the Architect or other responsible design professional with the District.
- C. Costs of services by Architect or other responsible design professional of the District shall be paid on a time and materials basis, based on current hourly fee schedules, with reproduction, long distance telephone and shipping costs reimbursable at cost plus usual and customary mark-up for handling and billing.
- D. Such fees shall be paid whether or not the proposed substitution or alternative sequence or method of construction is ultimately accepted by District and a Change Order is executed.
- E. Such fees shall be paid from Contractor's portion of savings, if a net reduction in Contract Sum results. If fees exceed Contractor's portion of net reduction, Contractor shall pay all remaining fees unless otherwise agreed in advance by the District.
- F. Such fees owed shall be deducted from the amount owed Contractor on the Application for Payment next made following completion of revised Contract Drawings and Specifications or completion of research and other services. District will then pay Architect or other consultant of the District.
- G. Certain substitutions require approval from DSA.
 1. Substitutions affecting DSA-regulated items shall be considered as construction change documents (CCD's) and shall be approved by DSA prior to construction per DSA IR A-6 and Section 338(c) Part 1, Title 24 CCR. See Section 01 20 00 - Price and Payment Procedures.

3.05 RESOLUTION

- A. Architect may request additional information and documentation prior to rendering a decision. Provide this data in an expeditious manner.
- B. Architect will notify Contractor in writing of decision to accept or reject request.
 1. Architect's decision following review of proposed substitution will be noted on the submitted form.

3.06 ACCEPTANCE

- A. Accepted substitutions change the work of the Project. They will be documented and incorporated into work of the project by Change Order, Construction Change Directive, Architectural Supplementary Instructions, or similar instruments provided for in the Conditions of the Contract.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

- B. Include completed Substitution Request Forms as part of the Project record. Include both approved and rejected Requests.

3.08 ATTACHMENTS

- A. A facsimile of the Substitution Request Form (During Construction) required to be used on the Project is included after this section.

END OF SECTION

SECTION 01 30 00 ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General administrative requirements.
- B. Electronic document submittal service.
- C. Preconstruction meeting.
- D. Site mobilization meeting.
- E. Progress meetings.
- F. Contractor's daily reports.
- G. Progress photographs.
- H. Coordination drawings.
- I. Submittals for review, information, and project closeout.
- J. Number of copies of submittals.
- K. Requests for Interpretation or Information (RFI) procedures.
- L. Submittal procedures.

1.02 RELATED REQUIREMENTS

- A. Section 01 60 00 - Product Requirements: General product requirements.
- B. Section 01 70 00 - Execution and Closeout Requirements: Additional coordination requirements.
- C. Section 01 78 00 - Closeout Submittals: Project record documents; operation and maintenance data; warranties and bonds.
- D. Section 01 91 13 - General Commissioning Requirements: Additional procedures for submittals relating to commissioning.
- E. Technical Product Sections: Procedures for specific submittals specified in those Sections to be made at Contract closeout.

1.03 DEFINITIONS

- A. Action Submittals: Written and graphic information that requires responsive action by Construction Manager and Architect or other responsible design professional.
- B. Informational Submittals: Written information that does not require responsive action by Construction Manager and Architect or other responsible design professional.
- C. Unsolicited Submittals: Action or informational submittals not required by the Contract Documents or not requested by the reviewer. Unsolicited submittals may be returned with notation "not reviewed."
- D. Product Data: Standard published information ("catalog cuts") and specially prepared data for the Work of the Contract, including standard illustrations, schedules, brochures, diagrams, performance charts, instructions and other information to illustrate a portion of the Work.

- E. Request for Interpretation or Information (RFI): A document submitted by the Contractor requesting clarification of a portion of the Contract Documents, hereinafter referred to as an RFI.
- F. Samples: Physical examples that demonstrate the materials, finishes, features, workmanship and other characteristics of a portion of the Work. Accepted samples shall serve as quality basis for evaluating the Work.
- G. Shop Drawings, Product Data and Samples: Instruments prepared and submitted by Contractor, for Contractor's benefit, to communicate to Architect the Contractor's understanding of the design intent, for review and comment by Architect on the conformance of the submitted information to the general intent of the design. Shop drawings, product data and samples are not Contract Documents.
- H. Shop Drawings: Drawings, diagrams, schedules and illustrations, with related notes, specially prepared for the Work of the Contract, to illustrate a portion of the Work.
- I. Other Submittals: Technical data, test reports, calculations, surveys, certifications, special warranties and guarantees, operation and maintenance data, extra stock and other submitted information and products shall not be considered as Contract Documents but shall be information from Contractor to Architect to illustrate a portion of the Work for confirmation of understanding of design intent.

1.04 PROJECT COORDINATOR

- A. Project Coordinator: Construction Manager.
- B. Cooperate with the Project Coordinator in allocation of mobilization areas of site; for field offices and sheds, for material delivery access, traffic, and parking facilities.
 - 1. Comply with requirements of Section 01 70 00 - Execution and Closeout Requirements for coordination of execution of administrative tasks with timing of construction activities.
- C. During construction, coordinate use of site and facilities through the Project Coordinator.
- D. Comply with Project Coordinator's procedures for intra-project communications; submittals, reports and records, schedules, coordination drawings, and recommendations; and resolution of ambiguities and conflicts.
- E. Comply with instructions of the Project Coordinator for use of temporary utilities and construction facilities. Responsibility for providing temporary utilities and construction facilities is identified in Section 01 10 00 - Summary.
- F. Coordinate field engineering and layout work under instructions of the Project Coordinator.
- G. Make the following types of submittals to Architect through the Project Coordinator:
 - 1. Requests for Interpretation or Information.
 - 2. Requests for substitution.
 - 3. Shop drawings, product data, and samples.
 - 4. Test and inspection reports.
 - 5. Manufacturer's instructions and field reports.
 - 6. Applications for payment and change order requests.
 - 7. Progress schedules.
 - 8. Coordination drawings.
 - 9. Correction Punch List and Final Correction Punch List for Final Inspection.
 - 10. Closeout submittals.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 ELECTRONIC DOCUMENT SUBMITTAL SERVICE

- A. All documents transmitted for purposes of administration of the contract are to be in electronic (PDF, MS Word, or MS Excel) format, as appropriate to the document, and transmitted via an Internet-based submittal service that receives, logs and stores documents, provides electronic stamping and signatures, and notifies addressees via email.
 - 1. Besides submittals for review, information, and closeout, this procedure applies to Requests for Interpretation or Information (RFIs), progress documentation, contract modification documents (e.g. supplementary instructions, change proposals, change orders), applications for payment, field reports and meeting minutes, Contractor's correction punchlist, and any other document any participant wishes to make part of the project record.
 - 2. Contractor and Architect are required to use this service.
 - 3. It is Contractor's responsibility to submit documents in allowable format.
 - 4. Subcontractors, suppliers, and Architect's consultants are to be permitted to use the service at no extra charge.
 - 5. Users of the service need an email address, internet access, and PDF review software that includes ability to mark up and apply electronic stamps (such as Adobe Acrobat, www.adobe.com, or Bluebeam PDF Revu, www.bluebeam.com), unless such software capability is provided by the service provider.
 - 6. Unless specifically requested, paper document transmittals will not be reviewed; emailed electronic documents will not be reviewed.
 - 7. All other specified submittal and document transmission procedures apply, except that electronic document requirements do not apply to samples or color selection charts.
- B. Cost: The cost of the service is to be paid by Contractor; include the cost of the service in the Contract Sum.
- C. Submittal Service: The selected service is:
 - 1. Bluebeam Software Inc.; Bluebeam Revu Studio: www.bluebeam.com.
 - 2. Other Service acceptable to both District and Architect.
 - a. Direct email with PDF copies.
- D. Training: One, one-hour, web-based training session will be arranged for all participants, with representatives of Architect and Contractor participating; further training is the responsibility of the user of the service.
 - 1. Representatives of District are scheduled and included in this training.
- E. Project Closeout: Architect will determine when to terminate the service for the project and is responsible for obtaining archive copies of files for District.

3.02 PRECONSTRUCTION MEETING

- A. District will schedule a meeting after Notice of Award.
- B. Attendance Required:
 - 1. District.

2. Architect.
3. Contractor.
4. Construction Manager.

C. Agenda:

1. Execution of District-Contractor Agreement.
 2. Submission of executed bonds and insurance certificates.
 3. Distribution of Contract Documents.
 4. Submission of list of subcontractors, list of products, schedule of values, and progress schedule.
 5. Submission of initial Submittal schedule.
 6. Designation of personnel representing the parties to Contract and Architect.
 7. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, Change Orders, and Contract closeout procedures.
 8. Scheduling.
 9. Scheduling activities of a Geotechnical Engineer.
- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

3.03 SITE MOBILIZATION MEETING

- A. Project Coordinator will schedule meeting at the Project site prior to Contractor occupancy.

B. Attendance Required:

1. Contractor.
2. District.
3. Architect.
4. Construction Manager.
5. Special consultants.
6. Contractor's superintendent.
7. Major subcontractors.
8. Inspector of Record.
9. DSA Field Representative.

C. Agenda:

1. Designation of Key Personnel: Contractor shall designate key personnel and provide a name and address list which includes the following:
 - a. Contractor: Project Manager and Superintendent.
 - b. Major subcontractors: Principal/Project Manager and Superintendent.
 - c. Major materials suppliers: Contact person.
2. Distribute and discuss list of subcontractors and suppliers.
3. Project Communication Procedures: Review requirements and administrative requirements for written and oral communications.
 - a. Review requirements and administrative procedures Contractor may wish to institute for identification and reporting purposes.

4. Change Procedures: Review requirements and administrative procedures for Change Orders, Construction Change Directives, Architect's supplemental instructions and Contractor's Requests for Interpretation or Information.
5. Use of premises by District and Contractor.
 - a. Site access restrictions, if any, and requirements to avoid disruption of operations at adjoining facilities or operations.
 - b. Construction Facilities and Temporary Utilities: Designate storage and staging areas, construction office areas; review temporary utility provisions; present District's requirements for use of premises.
6. District's requirements.
7. Construction facilities and controls provided by District.
8. Temporary utilities provided by District.
9. Survey and building layout.
10. Security and housekeeping procedures.
11. Schedules.
 - a. Distribute and discuss initial construction schedule and critical work sequencing of major elements of Work;
 - b. Include coordination of District Furnished / Contractor Installed (OFCl) products;
 - c. Work under separate contracts by serving utility agencies;
 - d. Work under separate contracts by companies and District.
12. Review requirements for Contractor's coordination of Work; review sequence and schedule for work being performed for District under separate contracts.
13. Submittals Administration: Review administrative procedures for shop drawings, product data and samples submittals and review of preliminary Submittals Schedule.
14. Materials and Equipment:
 - a. Review substitution requirements;
 - b. Review schedule for major equipment purchases and deliveries;
 - c. Review materials and equipment to be provided by District (OFCl products).
15. Permits and Fees: Review Contract requirements and review schedule and process for obtaining permits and paying fees.
16. Application for payment procedures.
17. Procedures for testing.
 - a. Review tests and inspections to be performed by the following:
 - 1) Independent testing and inspection agency.
 - 2) Manufacturers and installers.
 - 3) Serving utilities and public agencies.
 - 4) Authorities having jurisdiction.
18. Procedures for maintaining record documents.
19. Requirements for start-up of equipment.
 - a. Operation and Maintenance Data:
 - 1) Format and content of operation and maintenance manuals; instruction of District's personnel.

20. Inspection and acceptance of equipment put into service during construction period.

- D. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

3.04 PROGRESS MEETINGS

- A. Schedule and administer meetings throughout progress of the work at maximum bi-weekly intervals.
- B. Make arrangements for meetings, prepare agenda with copies for participants, preside at meetings.
- C. Meeting Time and Location: As mutually agreed by District, Architect, and Contractor, at on-site location.
- D. Special Meetings: As necessary, Construction Manager may convene special meetings to discuss specific construction issues in detail and to plan specific activities.
1. See Section 01 70 00 - Execution and Closeout Requirements.
- E. Attendance Required:
1. Contractor.
2. District.
3. Architect.
4. Construction Manager.
5. Special consultants.
6. Contractor's superintendent.
7. Major subcontractors.
8. Inspector of Record.
- F. Agenda:
1. Review minutes of previous meetings.
- a. Unless published minutes are challenged in writing prior to the next regularly scheduled progress meeting, they will be accepted as properly stating the activities and decisions of the meeting.
- b. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.
- c. Challenge to minutes shall be settled as priority portions of "old business" at the next regularly scheduled meeting.
2. Review of work progress.
3. Field observations, problems, and decisions.
4. Identification of problems that impede, or will impede, planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of RFIs log and status of responses.
7. Review of off-site fabrication and delivery schedules.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
- a. Develop corrective measures and procedures, including but not necessarily limited to additional personnel loading to regain planned schedule.

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

3.05 CONSTRUCTION PROGRESS SCHEDULE

- A. Within 10 days after date of the Agreement, submit preliminary schedule defining planned operations for the first 60 days of work, with a general outline for remainder of work.
- B. Contractor's Review: All schedules shall be reviewed and approved by Contractor prior to submission for Architect's and District's review.
- C. Reviews by Architect and District will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.
- D. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- E. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- F. Within 10 days after joint review, submit complete schedule.
- G. Submit updated schedule with each Application for Payment.

3.06 DAILY CONSTRUCTION REPORTS

- A. Include only factual information. Do not include personal remarks or opinions regarding operations and/or personnel.
- B. In addition to transmitting electronically a copy to District and Architect, submit two printed copies at weekly intervals.
 1. Submit in format acceptable to District.
 2. Submit using required form, a sample of which is appended to this section.
- C. Prepare a daily construction report recording the following information concerning events at Project site and project progress:
 1. Date.
 2. High and low temperatures, and general weather conditions.
 3. List of subcontractors at Project site.
 4. List of separate contractors at Project site.
 5. Approximate count of personnel at Project site.
 - a. Include a breakdown for supervisors, laborers, journeymen, equipment operators, and helpers.
 6. Major equipment at Project site.
 7. Material deliveries.
 8. Safety, environmental, or industrial relations incidents.

9. Meetings and significant decisions.
10. Unusual events (submit a separate special report).
11. Stoppages, delays, shortages, and losses. Include comparison between scheduled work activities (in Contractor's most recently updated and published schedule) and actual activities. Explain differences, if any. Note days or periods when no work was in progress and explain the reasons why.
12. Meter readings and similar recordings.
13. Emergency procedures.
14. Directives and requests of Authority(s) Having Jurisdiction (AHJ).
15. Change Orders received and implemented.
16. Testing and/or inspections performed.
17. List of verbal instruction given by District and/or Architect.
18. Signature of Contractor's authorized representative.

3.07 PROGRESS PHOTOGRAPHS

- A. Submit photographs with each application for payment, taken not more than 3 days prior to submission of application for payment.
- B. Maintain one set of all photographs at project site for reference; same copies as submitted, identified as such.
- C. Photography Type: Digital; electronic files.
- D. Provide photographs of site and construction throughout progress of work produced by an experienced photographer, acceptable to Architect.
- E. In addition to periodic, recurring views, take photographs of each of the following events:
 1. Completion of site clearing.
 2. Excavations in progress.
 3. Foundations in progress and upon completion.
 4. Structural framing in progress and upon completion.
 5. Enclosure of building, upon completion.
 6. Final completion, minimum of ten (10) photos.
- F. Take photographs as evidence of existing project conditions as follows:
 1. Interior views: each elevation, floor and ceilings prior to demolition.
 2. Exterior views: each elevation, roof and areas adjacent to construction limits.
- G. Views:
 1. Provide non-aerial photographs from four cardinal views at each specified time, until date of Final Inspection.
 2. Consult with Architect for instructions on views required.
 3. Provide factual presentation.
 4. Provide correct exposure and focus, high resolution and sharpness, maximum depth of field, and minimum distortion.
 5. Point of View Sketch: Provide sketch identifying point of view of each photograph.
- H. Digital Photographs: 24 bit color, minimum resolution of 1024 by 768, in JPG format; provide files unaltered by photo editing software.

1. Delivery Medium: Via email.
2. File Naming: Include project identification, date and time of view, and view identification.
3. Point of View Sketch: Include digital copy of point of view sketch with each electronic submittal; include point of view identification in each photo file name.
4. PDF File: Assemble all photos into printable pages in PDF format, with 2 to 3 photos per page, each photo labeled with file name; one PDF file per submittal.
5. Photo CD(s): Provide 1 copy including all photos cumulative to date and PDF file(s), with files organized in separate folders by submittal date.
6. Hard Copy: Printed hardcopy (grayscale) of PDF file and point of view sketch.

3.08 COORDINATION DRAWINGS

- A. See Section 01 31 14 - Facility Services Coordination.
- B. Provide information required by Project Coordinator for preparation of coordination drawings.
- C. Review drawings prior to submission to Architect.

3.09 REQUESTS FOR INTERPRETATION OR INFORMATION (RFI)

- A. Definition: A request seeking one of the following:
 1. An interpretation, amplification, or clarification of some requirement of Contract Documents arising from inability to determine from them the exact material, process, or system to be installed; or when the elements of construction are required to occupy the same space (interference); or when an item of work is described differently at more than one place in the Contract Documents.
 2. A resolution to an issue which has arisen due to field conditions and affects design intent.
- B. Whenever possible, request clarifications at the next appropriate project progress meeting, with response entered into meeting minutes, rendering unnecessary the issuance of a formal RFI.
- C. Preparation: Prepare an RFI immediately upon discovery of a need for interpretation of Contract Documents. Failure to submit a RFI in a timely manner is not a legitimate cause for claiming additional costs or delays in execution of the work.
 1. Prepare a separate RFI for each specific item.
 - a. Review, coordinate, and comment on requests originating with subcontractors and/or materials suppliers.
 - b. Do not forward requests which solely require internal coordination between subcontractors.
 2. Prepare in a format and with content acceptable to District.
 3. Combine RFI and its attachments into a single electronic file. PDF format is preferred.
- D. Reason for the RFI: Prior to initiation of an RFI, carefully study all Contract Documents to confirm that information sufficient for their interpretation is definitely not included.
 1. Include in each request Contractor's signature attesting to good faith effort to determine from Contract Documents information requiring interpretation.
 - a. Submit RFIs from subcontractors and material suppliers through, be reviewed by and be attached to an RFI prepared, signed and submitted by Contractor.
 - 1) RFIs from subcontractors and material suppliers are to be:
 - (a) Reviewed by Contractor.
 - (b) Corrected and rewritten to clarify as required by Contractor.

- (c) Placed on the proper form, then signed, and submitted by Contractor.
 - (d) RFIs submitted directly by subcontractors or material suppliers will be returned unanswered to the Contractor.
 - 2) RFIs submitted directly by subcontractors or material suppliers will be returned unanswered to the Contractor.
 - b. Review all subcontractor- and supplier-initiated RFIs and take actions to resolve issues of coordination, sequencing and layout of the Work.
 - 1) RFIs submitted to request clarification of issues related to means, methods, techniques and sequences of construction or for establishing trade jurisdictions and scopes of subcontracts will be returned without response.
 - (a) Such issues are solely the Contractor's responsibility.
 - 2) Contractor is responsible for delays resulting from the necessity to resubmit an RFI due to insufficient or incorrect information presented in the RFI.
2. Unacceptable Uses for RFIs: Do not use RFIs to request the following::
- a. Approval of submittals (use procedures specified elsewhere in this section).
 - b. Approval of substitutions (see Section - 01 60 00 - Product Requirements)
 - c. Changes that entail change in Contract Time and Contract Sum (comply with provisions of the Conditions of the Contract).
 - d. Different methods of performing work than those indicated in the Contract Drawings and Specifications (comply with provisions of the Conditions of the Contract).
3. Improper RFIs: Requests not prepared in compliance with requirements of this section, and/or missing key information required to render an actionable response. They will be returned without a response, with an explanatory notation.
4. Frivolous RFIs: Requests regarding information that is clearly indicated on, or reasonably inferable from, Contract Documents, with no additional input required to clarify the question. They will be returned without a response, with an explanatory notation.
- a. The District reserves the right to assess the Contractor for the costs (on time-and-materials basis) incurred by the Architect, and any of its consultants, due to processing of such RFIs.
- E. Content: Include identifiers necessary for tracking the status of each RFI, and information necessary to provide an actionable response.
- 1. Official Project name and number, and any additional required identifiers established in Contract Documents.
 - 2. District's, Architect's, and Contractor's names.
 - 3. Discrete and consecutive RFI number, and descriptive subject/title.
 - 4. Issue date, and requested reply date.
 - 5. Reference to particular Contract Document(s) requiring additional information/interpretation. Identify pertinent drawing and detail number and/or specification section number, title, and paragraph(s).
 - 6. Annotations: Field dimensions and/or description of conditions which have engendered the request.
 - a. Inability to determine from the Contract Documents the exact material, process, or system to be installed;
 - b. Or when the elements of construction are required to occupy the same space (interference);

- c. Or when an item of Work is described differently at more than one place in the Contract Documents.
- 7. Contractor's suggested resolution: A written and/or a graphic solution, to scale, is required in cases where clarification of coordination issues is involved, for example; routing, clearances, and/or specific locations of work shown diagrammatically in Contract Documents. If applicable, state the likely impact of the suggested resolution on Contract Time or the Contract Sum.
 - a. In all cases, furnish all information required for the Architect to analyze and/or understand the circumstances causing the RFI and prepare a clarification or direction as to proceed for RFIs issued to request clarification of issues related to:
 - 1) Means, methods, techniques and sequences of construction, for example
 - 2) Pipe and duct routing, clearances;
 - 3) Specific locations of Work shown diagrammatically;
 - 4) Apparent interferences and similar items.
 - 5) If information included with this type RFI by the Contractor is insufficient, the RFI will be returned unanswered.
- F. Attachments: Include sketches, coordination drawings, descriptions, photos, submittals, and other information necessary to substantiate the reason for the request.
- G. RFI Log: Prepare and maintain a tabular log of RFIs for the duration of the project.
 - 1. Indicate current status of every RFI. Update log promptly and on a regular basis.
 - 2. Note dates of when each request is made, and when a response is received.
 - 3. Highlight items requiring priority or expedited response.
 - 4. Highlight items for which a timely response has not been received to date.
 - 5. Identify and include improper or frivolous RFIs.
- H. Review Time: Architect will respond and return RFIs to Contractor within seven calendar days of receipt. For the purpose of establishing the start of the mandated response period, RFIs received after 12:00 noon will be considered as having been received on the following regular working day.
 - 1. Response period may be shortened or lengthened for specific items, subject to mutual agreement, and recorded in a timely manner in progress meeting minutes.
- I. Responses: Content of answered RFIs will not constitute in any manner a directive or authorization to perform extra work or delay the project. If in Contractor's belief it is likely to lead to a change to Contract Sum or Contract Time, promptly issue a notice to this effect, and follow up with an appropriate Change Order request to District.
 - 1. Response may include a request for additional information, in which case the original RFI will be deemed as having been answered, and an amended one is to be issued forthwith. Identify the amended RFI with an R suffix to the original number.
 - 2. Do not extend applicability of a response to specific item to encompass other similar conditions, unless specifically so noted in the response.
 - 3. Upon receipt of a response, promptly review and distribute it to all affected parties, and update the RFI Log.
 - 4. Notify Architect within seven calendar days if an additional or corrected response is required by submitting an amended version of the original RFI, identified as specified above.

3.10 SUBMITTAL SCHEDULE

- A. Submit to Architect for review a schedule for submittals in tabular format.
 - 1. Submit at the same time as the preliminary schedule.
 - a. Submit initial Submittals Schedule within 14 days of date of Notice of Award of construction.
 - b. After review and return by Architect, resubmit Submittals Schedule within 10 days and thereafter submit updated Submittals Schedules at each Construction Progress Meeting.
 - c. Submit one copy each to Owner and Architect.
 - 2. Coordinate with Contractor's construction schedule and schedule of values.
 - 3. Format schedule to allow tracking of status of submittals throughout duration of construction.
 - a. Prepare schedules in Gantt format using software at Contractor's option, providing clear indication of sequencing and scheduling of Work, for determination of "critical path" of construction progress.
 - 1) Submittals shall be connected to the related construction element by a graphically indicated critical path on the same page.
 - 2) Present schedules using opaque reproductions on substantial paper, with sheet size a multiple of 8-1/2 by 11 inches and large enough to clearly read characters.
 - 4. Arrange information to include scheduled date for initial submittal, specification number and title, submittal category (for review or for information), description of item of work covered, and role and name of subcontractor.
 - 5. Account for time required for preparation, review, manufacturing, fabrication and delivery when establishing submittal delivery and review deadline dates.
 - a. For assemblies, equipment, systems comprised of multiple components and/or requiring detailed coordination with other work, allow for additional time to make corrections or revisions to initial submittals, and time for their review.
 - b. Allow time for shipping and distribution to involved parties. Minimum 1 day, including those sent by electronic transmission.
 - 6. Posting: Post one copy of most recent Submittals Schedule in Contractor's field office, readily available to District, Construction Manager, and Architect. Update bi-weekly with project schedule.
 - 7. Archive: Preserve a minimum of two copies of all superseded schedules, with one copy available at field office for review by District or Architect.

3.11 SUBMITTALS FOR REVIEW

- A. When the following are specified in individual sections, submit them for review:
 - 1. Product data.
 - 2. Shop drawings.
 - 3. Samples for selection.
 - 4. Samples for verification.
- B. Submit to Architect for review for the limited purpose of checking for compliance with information given and the design concept expressed in Contract Documents.
- C. Samples will be reviewed for aesthetic, color, or finish selection.

- D. After review, provide copies and distribute in accordance with SUBMITTAL PROCEDURES article below and for record documents purposes described in Section 01 78 00 - Closeout Submittals.

3.12 SUBMITTALS FOR INFORMATION

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

3.13 SUBMITTALS FOR COMMISSIONING

- A. The Commissioning Authority will receive a copy of the standard submittals for equipment to be commissioned.
- B. The Commissioning Authority may require additional documentation necessary for the commissioning process. The Contractor will receive a written request from the Commissioning Authority for specific equipment or system information.

3.14 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit Correction Punch List for Substantial Completion.Final Inspection.
- B. Submit Final Correction Punch List for Final Inspection.
- C. When the following are specified in individual sections, submit them at project closeout in compliance with requirements of Section 01 78 00 - Closeout Submittals:
 - 1. Project record documents.
 - 2. Operation and maintenance data.
 - a. Include operation and maintenance data submittals in Submittals Schedule specified above.
 - b. Provide space for review action stamps and, if required by governing authorities having jurisdiction, license seal of design Professional, if applicable.
 - 3. Warranties.
 - 4. Bonds.
 - 5. Other types as indicated.
- D. Submit for District's benefit during and after project completion.

3.15 NUMBER OF COPIES OF SUBMITTALS

- A. Electronic Documents: Submit one electronic copy in PDF format with renderable text; an electronically-marked up file will be returned. Create PDFs at native size and right-side up; illegible files will be rejected.
- B. Small Size Sheets, Not Larger Than 11 by 17 inch: Submit one copy; the Contractor shall make his own copies from original returned by the Architect after making his own file copy.

- C. Extra Copies at Project Closeout: See Section 01 78 00.
- D. Samples: Submit the number specified in individual specification sections; one of which will be retained by Architect.
 - 1. After review, produce duplicates.
 - 2. Retained samples will not be returned to Contractor unless specifically so stated.
 - 3. Quantity:
 - a. Submit minimum of four (4) samples of each of color, texture and pattern.
 - b. Submit one item only of actual assembly or product.
 - c. Unless otherwise noted, full-size and complete samples will be returned and may be incorporated into field mock-ups and the Work.

3.16 SUBMITTAL PROCEDURES

- A. General Requirements:
 - 1. Use a separate transmittal for each item.
 - 2. Submit separate packages of submittals for review and submittals for information, when included in the same specification section.
 - 3. Transmit using approved form.
 - 4. Sequentially identify each item. For revised submittals use original number and a sequential numerical suffix.
 - 5. Identify: Project; Contractor; subcontractor or supplier; pertinent drawing and detail number; and specification section number and article/paragraph, as appropriate on each copy.
 - a. For example:
 - 1) 09 21 16-1 - First submittal for Section 09 21 16 - Gypsum Board Assemblies.
 - 2) 09 21 16-2 - Second submittal for Section 09 21 16 - Gypsum Board Assemblies.
 - b. Use same number for resubmittals as original submittal, followed by a letter indicating sequential resubmittal. For example:
 - 1) 09 21 16-2A - Resubmission of second submittal for Section 09 21 16 - Gypsum Board Assemblies.
 - 2) 09 21 16-2B - Second resubmission of second submittal for Section 09 21 16 - Gypsum Board Assemblies.
 - 6. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction work, and coordination of information is in accordance with the requirements of the work and Contract Documents.
 - a. Submittals from sources other than the Contractor, or without Contractor's stamp will not be acknowledged, reviewed, or returned.
 - b. Field measurements have been determined and verified.
 - c. Conformance with requirements of Contract Drawings and Specifications is confirmed.
 - d. Catalog numbers and similar data are correct.
 - e. Work being performed by various subcontractors and trades is coordinated.

- f. Field construction criteria have been verified, including confirmation that information submitted has been coordinated with the work being performed by others for District and actual site conditions.
 - g. All deviations from requirements of Drawings and Specifications have been identified and noted.
 - 7. Deliver each submittal on date noted in submittal schedule, unless an earlier date has been agreed to by all affected parties, and is of the benefit to the project.
 - a. Send submittals in electronic format via email to Architect.
 - b. Upload submittals in electronic form to Electronic Document Submittal Service website.
 - 8. Schedule submittals to expedite the Project, and coordinate submission of related items.
 - a. For each submittal for review, allow 15 days excluding delivery time to and from the Contractor.
 - b. For sequential reviews involving Architect's consultants, District, or another affected party, allow an additional 7 days.
 - c. For sequential reviews involving approval from authorities having jurisdiction (AHJ), in addition to Architect's approval, allow an additional 30 days.
 - 9. Identify variations from Contract Documents and product or system limitations that may be detrimental to successful performance of the completed work.
 - a. Changes in the Work shall not be authorized by submittals review actions.
 - b. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
 - c. Changes shall only be authorized by separate written Contract Change Order or Construction Change Directive, in accordance with the Conditions of the Contract and Section 01 20 00 - Price and Payment Procedures.
 - 10. Provide space for Contractor and Architect review stamps.
 - 11. When revised for resubmission, identify all changes made since previous submission.
 - 12. Distribute reviewed submittals. Instruct parties to promptly report inability to comply with requirements.
 - 13. Incomplete submittals will not be reviewed, unless they are partial submittals for distinct portion(s) of the work, and have received prior approval for their use.
 - 14. Submittals not requested will be recognized, but will be returned without comment,
- B. Product Data Procedures:
 - 1. Submit only information required by individual specification sections.
 - 2. Collect required information into a single submittal.
 - 3. Submit concurrently with related shop drawing submittal.
 - 4. Do not submit (Material) Safety Data Sheets for materials or products.
- C. Shop Drawing Procedures:
 - 1. Prepare accurate, drawn-to-scale, original shop drawing documentation by interpreting Contract Documents and coordinating related work.
 - 2. Use of reproductions of Contract Documents in digital data form to create shop drawings is only permitted as defined in Division 01 and individual product sections.
 - 3. Coordination: Show all field dimensions and relationships to adjacent or critical features of Work.

4. Generic, non-project-specific information submitted as shop drawings do not meet the requirements for shop drawings.
- D. Samples Procedures:
 1. Transmit related items together as single package.
 2. Samples will be reviewed for aesthetic, color, or finish selection.
 3. Identify each item to allow review for applicability in relation to shop drawings showing installation locations.
 4. Color Selection Samples: Architect will review and select colors for Project only after all colors are received, so that colors may be properly coordinated.
 5. Copies: Submit actual samples. Photographic or printed reproductions will not be accepted.
 6. Review of Field Samples: Review by Architect of field samples will be made for the following example products, as applicable, if not otherwise required and if requested by Contractor.
 - a. Concrete wall finishes and detailing (edges, corners and reveals).
 - b. Concrete paving colors and textures.
 - c. Gypsum board textures and finishes.
 - d. Field-applied paint colors and finishes.

3.17 SUBMITTAL REVIEW

- A. Submittals for Review: Architect will review each submittal, and approve, or take other appropriate action.
- B. Submittals for Information: Architect will acknowledge receipt and review. See below for actions to be taken.
- C. Architect's actions will be reflected by marking each returned submittal using virtual stamp on electronic submittals.
 1. Notations may be made directly on submitted items and/or listed on appended Submittal Review cover sheet.
- D. Architect's and consultants' actions on items submitted for review:
 1. Authorizing purchasing, fabrication, delivery, and installation:
 - a. "Approved", "Reviewed", or language with same legal meaning.
 - b. "Approved as Noted, Resubmission not required", or language with same legal meaning.
 - 1) At Contractor's option, submit corrected item, with review notations acknowledged and incorporated.
 - c. "Approved as Noted, Resubmit for Record", "Reviewed as Noted, Resubmit for Record", or language with same legal meaning.
 - 1) Resubmit corrected item, with review notations acknowledged and incorporated. Resubmit separately, or as part of project record documents.
 - 2) Non-responsive resubmittals may be rejected.
 2. Not Authorizing fabrication, delivery, and installation:
 - a. "Revise and Resubmit".
 - 1) Resubmit revised item, with review notations acknowledged and incorporated.

- 2) Non-responsive resubmittals may be rejected.
 - b. "Rejected".
 - 1) Submit item complying with requirements of Contract Documents.
- E. Architect's and consultants' actions on items submitted for information:
 - 1. Items for which no action was taken:
 - a. "Received" - to notify the Contractor that the submittal has been received for record only.
 - 2. Items for which action was taken:
 - a. "Reviewed" - no further action is required from Contractor.

END OF SECTION

SECTION 01 30 00.01
REQUEST FOR INTERPRETATION

RFI NUMBER: _____ **DATE:** _____

PROJECT NAME: BATTLES ES - TK-K BUILDING AND SITE UPGRADES **PROJECT NO.: 75-24119-000**

TO: DLR GROUP

700 South Flower Street, 22nd Floor, Los Angeles CA 90017

Attention: _____

Contractor: _____

Address: _____

BRIEF SUMMARY OF RFI:

Drawing No. _____ Detail No. _____

Specification Section _____ Title _____

.Page _____ Paragraph _____

DETAILS OF THIS RFI:

SUGGESTED SOLUTION:

Response required by: _____ (min. 3 full days) Submitted By: _____

. Organization: _____

RESPONSE:

Attachments: _____

Response By: _____ Date: _____

Organization: _____

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

Copies: ☐ File ☐ District ☐ Structural ☐ Mechanical ☐ Plumbing ☐ Electrical
☐ Civil ☐ Landscape ☐ other consultants

END OF RFI

SECTION 01 31 14 FACILITY SERVICES COORDINATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Services of a coordinator for facility services construction.
- B. Coordination documents.
 - 1. BIM Coordination drawings for the various trades of this project.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Responsibilities of separate contractors.
 - 1. Various types of Work to be coordinated, including Owner-Furnished / Contractor-Installed products.
- B. Section 01 30 00 - Administrative Requirements: Additional requirements for coordination.
- C. Section 01 60 00 - Product Requirements: Spare parts and maintenance materials.
 - 1. Coordination of products, especially general requirements for system completeness and product substitutions.
- D. Section 01 70 00 - Execution and Closeout Requirements: Starting of Systems. Systems Demonstration.
- E. Section 01 78 00 - Closeout Submittals: Project record documents.

1.03 MECHANICAL AND ELECTRICAL COORDINATOR

- A. Employ and pay for services of a person, technically qualified and administratively experienced in field coordination of the type of work required to be coordinated, for the duration of the Work.
 - 1. This designated individual may serve a dual role on the project team.

1.04 SUBMITTALS

- A. Submit name, address, and telephone number of coordinator and name of principal officer for review.
- B. Submit coordination drawings and schedules prior to submitting shop drawings, product data, and samples.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 COORDINATION REQUIRED

- A. Coordinate the Work as stated in the Conditions of the Contract.
 - 1. Coordinate Work under the Contract with work under separate contracts by District.
 - 2. Preinstallation Meetings: Coordinate and document work between trades. See Section 01 70 00 - Execution and Closeout Requirements.

3. Cooperate with District, Construction Manager, and others as directed by District in scheduling and sequencing the incorporation into the Work of Owner Furnished / Contractor Installed (OFICI) products identified in the Contract Drawings and Specifications.
- B. Relationship of Documents:
 1. Drawings, Specifications and other Contract Documents in the Project Manual are intended to be complementary.
 2. What is required by one shall be as if required by all.
 3. What is shown or required, or may be reasonably inferred to be required, or which is usually and customarily provided for similar work, shall be included in the Work.
- C. Discrepancies:
 1. Error, omission, ambiguity or conflict in Drawings or Specifications shall be brought to Architect's attention during the bidding period, for Architect's determination and direction in accordance with provisions of the Conditions of the Contract.
- D. Construction Interfacing and Coordination: Layout, scheduling and sequencing of Work shall be solely the Contractor's responsibility.
 1. Contractor shall verify, confirm and coordinate field measurements so that new construction correctly and accurately interfaces with conditions existing prior to construction.
- E. Contractor shall bring together the various parts, components, systems and assemblies as required for the correct interfacing and interpretation of all elements of the Work.
 1. All work required to provide complete and fully operational systems shall be included in the contract price.
 2. Contractor shall coordinate Work to correctly and accurately connect abutting, adjoining, overlapping and related elements, including work under separate contracts by District, utility agencies and companies.
- F. Coordinate the work listed below:
 1. Structural: Division 03, Division 04, Division 05, and Division 06.
 2. Architectural: Division 7, Division 8, Division 9, and Division 12.
 3. Specialties: Division 10.
 4. Equipment: Division 11.
 - a. Specialty Equipment.
 5. Special Construction: Division 13.
 6. Conveying: Division 14
 7. Fire Suppression: Division 21.
 8. Plumbing: Division 22.
 9. Heating, Ventilating, and Air Conditioning: Division 23.
 10. Electrical: Division 26.
 11. Communications: Division 27.
 12. Electronic Safety and Security: Division 28.
 13. Site Utilities: Division 33.
- G. Coordinate progress schedules, including dates for submittals and for delivery of products.

- H. Conduct meetings among subcontractors and others concerned, to establish and maintain coordination and schedules, and to resolve coordination matters in dispute.
- I. Participate in progress meetings. Report on progress of work to be adjusted under coordination requirements, and any required changes in schedules. Transmit minutes of meetings and reports to concerned parties.
- J. Coordination of subcontracts and separate contracts
 - 1. Superintendence of Work:
 - a. Contractor shall appoint a field superintendent and a project manager, who shall directly and full time supervise and coordinate all Work of the Contract.
 - 2. Subcontractors, Trades and Materials Suppliers:
 - a. Require all subcontractors, trades, crafts and suppliers to coordinate their portions of Work with the Contractor's field superintendent to prevent scheduling, sequencing, dimensional and other conflicts and omissions.
 - 3. Coordination with Work Under Separate Contracts:
 - a. Coordinate and schedule Work under the Contract with work being performed for Project under separate contracts by District, serving utilities and public agencies.
 - b. Make and facilitate direct contacts with parties responsible for work of the Project under separate contracts, in order to provide timely notifications and to facilitate information exchanges.

3.02 COORDINATION DOCUMENTS

- A. Prepare coordination drawings to organize installation of products for efficient use of available space, for proper sequence of installation, and to identify potential conflicts.
 - 1. Produce BIM Drawings with clash detection for the proposed installation and the placement of pipes, conduits, other materials, and the locations, size and reinforcement of penetrations in the building structure to conform to the structural Drawing and Specifications.
 - 2. Structural requirements take precedence when the requirements of the Mechanical, Electrical or other items are in conflict with structural.
 - 3. Take all precautions prior to coring into an existing building structure.
 - 4. Notify the structural engineer and obtain written approval prior to completing any structural penetrations if the structural integrity of an existing or new building structure may be compromised. Refer to Section 01 70 00 - Execution and Closeout Requirements for cutting and patching.
 - 5. Review limitations in available space for installation or service.
 - a. Overlay plans of each trade and verify space requirements and conflicts between trades.
 - b. Minor changes and adjustments that do not affect design intent may be made by Contractor and highlighted for Architect's review prior to purchase and installation.
 - 6. Incompatibility between items provided under different trades.
 - 7. Inconsistencies between drawings, specifications and codes (between trades and within each trade).
 - 8. Items required for existing facilities construction projects are designed and prepared from available as-built drawings that are verified through non-invasive and non-destructive, visual observation only.

- a. Field verify actual existing conditions during and upon completion of demolition work and incorporate findings into preparation of coordination drawings.
 - b. Minor changes and adjustments that do not affect design intent may be made by Contractor and highlighted for Construction Manager and Architect's review prior to purchase and installation.
- B. Prepare a master schedule identifying responsibilities for activities that directly relate to this work, including submittals and temporary utilities; organize by specification section.
- C. Verify that utility, and other building system requirement characteristics of operating equipment are compatible with provided utilities, and other building systems.
 1. Coordinate work of various trades having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.
- D. Identify electrical power characteristics and control wiring required for each item of equipment.
- E. Maintain documents for the duration of the work, recording changes due to site instructions, modifications or adjustments.
- F. After Architect review of original and revised documents, reproduce and distribute copies to concerned parties.

3.03 COORDINATION DRAWINGS / BIM MODEL

- A. Building Information Modeling (BIM) is required for this Project, such as 3-D Clash Coordination. Submit a BIM Project Execution Plan for Program Project Manager and Design Professional review. The plan shall at minimum include the following items.
 1. Project Goals/ BIM uses and Objectives: Clear objective and goals. Align objectives with Construction Documents and Agreement.
 2. Project Information: Provide key project contacts including project name, contract type, delivery method, project description, project schedule, phases, and milestones.
 - a. Key Project Contacts:
 - 1) Project Managers.
 - 2) BIM Manager.
 - 3) Trade BIM Managers.
 - 4) Superintendents and other major project roles.
 - b. BIM and Trade BIM Managers must have at least two years of BIM experience of similar size projects.
 - c. Organizational Roles and Staffing: Define roles in each organization and specific responsibilities.
 3. BIM Information Exchanges:
 - a. Identify the information exchanges created as part of the planning process in the BIM Project Execution Plan.
 - b. Information exchanges are to illustrate the model elements by discipline, level of detail, and any specific attributes important to the project.
 4. Collaboration Procedures:
 - a. Develop Team electronic and activity collaboration procedures.
 - b. Includes model management and standard meeting actions and agendas.
 5. Quality Control: Project teams should determine and document their overall strategy for quality control of the model.

6. Model Structure: The team must identify the methods to ensure model accuracy and comprehensiveness.
7. Project Deliverables: Identify project deliverables as required by Construction Manager.
8. Field Execution of final BIM product: Outline how the final BIM deliverables will be executed to reduce construction errors, change orders, and trade scheduling issues.

3.04 COORDINATION OF SUBMITTALS

- A. Review shop drawings, product data, and samples for compliance with Contract Documents and for coordination with related work. Transmit copies of reviewed documents to Architect.
- B. Check field dimensions and clearances and relationship to available space and anchors.
- C. Check compatibility with equipment and work of other sections, electrical characteristics, and operational control requirements.
- D. Check motor voltages and control characteristics.
- E. Coordinate controls, interlocks, wiring of switches, and relays.
- F. Coordinate wiring and control diagrams.
- G. When changes in the work are made, review their effect on other work.
- H. Verify information and coordinate maintenance of record documents.

3.05 COORDINATION OF SUBSTITUTIONS AND MODIFICATIONS

- A. Review proposals and requests for substitution prior to submission to Architect.
- B. Verify compliance with Contract Documents and for compatibility with work of other sections.
- C. Submit with recommendation for action.

3.06 OBSERVATION OF WORK

- A. Observe work for compliance with Contract Documents.
- B. Maintain a list of observed deficiencies and defects; promptly submit.

3.07 DOCUMENTATION

- A. Observe and maintain a record of tests. Record:
 1. Specification section number and product name.
 2. Name of Contractor, subcontractor and special inspector.
 3. Name of testing agency and name of inspector.
 4. Name of manufacturer's representative present.
 5. Date, time, and duration of tests.
 6. Type of test, and results.
 7. Retesting required.
- B. Assemble background documentation for dispute and claim settlement.
- C. Submit copies of documentation to Architect upon request.

3.08 EQUIPMENT START-UP

- A. Verify utilities, connections, and controls are complete and equipment is in operable condition as required by Section 01 70 00.
- B. Observe start-up and adjustments, test run, record time and date of start-up, and results.

- C. Observe equipment demonstrations made to District; record times and additional information required for operation and maintenance manuals.

3.09 INSPECTION AND ACCEPTANCE OF EQUIPMENT

- A. Prior to inspection, verify that equipment is tested, operational, clean, and ready for operation.
- B. Assist Architect with review. Prepare list of items to be completed and corrected.

END OF SECTION

SECTION 01 32 16 CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Responsibilities of individual Multi-Prime Contractors to coordinate with the Construction Manager's Master Project Schedule.
- B. Preliminary schedule.
- C. Construction progress schedule, with network analysis diagrams and reports.
- D. Summary schedule.
- E. Weekly/Short term (Look Ahead) Schedule.

1.02 RELATED SECTIONS

- A. Section 01 10 00 - Summary: Work sequence.
- B. Section 01 30 00 - Administrative Requirements: Submittal Schedule.

1.03 REFERENCE STANDARDS

- A. AGC (CPSM) - Construction Planning and Scheduling Manual; 2004.
- B. M-H (CPM) - CPM in Construction Management - Project Management with CPM; 2016.

1.04 SUBMITTALS

- A. Within 10 days after date of Agreement, submit preliminary schedule.
- B. Submit two copies to Construction Manager and one copy to Architect.
- C. If preliminary schedule requires revision after review, submit revised schedule within 10 days.
- D. Within 20 days after review of preliminary schedule, submit draft of proposed complete schedule for review.
 - 1. Include written certification that major contractors have reviewed and accepted proposed schedule.
- E. Within 10 days after joint review, submit complete schedule.
- F. Submit updated schedule with each Application for Payment.
 - 1. Revise schedule also upon issuance of Change Orders and Construction Change Directives which substantially affect construction sequence or schedule.
- G. Submit the number of opaque reproductions that Contractor requires, plus two copies that will be retained by Architect.
- H. Submit under transmittal letter form specified in Section 01 30 00 - Administrative Requirements.

1.05 QUALITY ASSURANCE

- A. Scheduler: Contractor's personnel or specialist Consultant specializing in CPM scheduling with one year's minimum experience in scheduling construction work of a complexity comparable to this Project, and having use of computer facilities capable of delivering a detailed graphic printout within 48 hours of request.

1. Designate the Scheduler in writing and within ten (10) workdays after Notice of Intent to Award, as the qualified responsible person for preparation, maintenance, updating, and revision of all schedules for the full term of construction.
 2. Scheduler:
 - a. Dedicated to this project and available on-site as needed to meet the strict requirement of this spec. section.
 - b. All scheduling software and hardware located on-site.
 - c. Scheduler will attend all project meetings called for as specified in Division 01.
 3. Qualifications of responsible person:
 - a. Knowledge of critical path method (CPM) scheduling utilizing Primavera P6 latest release software.
 4. References:
 - a. Submit written reference of three (3) project Owners who have personal experience with this scheduler on previous projects.
 - b. Identify name, address, telephone number, project name, and cost.
 5. District reserves the right to disapprove Scheduler when submitted by Contractor based on his/or her sole discretion. District reserves the right to remove Scheduler from the project without cause.
- B. Contractor's Administrative Personnel: Three years minimum experience in using and monitoring CPM schedules on comparable projects.
- C. Reviews by Architect and Construction Manager: Reviews by Architect and Construction Manager will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.
- D. Contractor's Review: All schedules shall be reviewed and approved by Contractor prior to submission for Architect's and District's review.
- E. Changes and Deviations: Identify all deviations from requirements of Drawings and Specifications.
1. Changes in the Work shall not be authorized by submittals review actions.
 2. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
 3. Changes shall only be authorized by separate written Change Order or Field Change Directive, in accordance with the Conditions of the Contract.

1.06 SCHEDULE FORMAT

- A. Format: Prepare schedules in format at Contractor's option, either bar chart, PERT or GANTT format, providing clear indication of sequencing and scheduling of Work, for determination of "critical path" of construction progress.
1. Prepare schedules in MS Project or Primavera.
 2. Provide clear indication of sequencing and scheduling of work for determination of "critical path" of construction progress.
 3. Present schedule in both electronic and reproducible paper formats with sheet size large enough to clearly read the characters.
- B. Listings: In chronological order according to the start date for each activity. Identify each activity with the applicable specification section number.
- C. Diagram Sheet Size: Maximum 30 x 42 inches.

- D. Sheet Size: Multiples of 8-1/2 x 11 inches.
- E. Scale and Spacing: To allow for notations and revisions.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PRELIMINARY SCHEDULE

- A. Prepare preliminary schedule in the form of a preliminary network diagram.
- B. Prescheduling Conference:
 - 1. Construction Manager will conduct a conference within fifteen (15) work days after the Notice of Intent to Award.
 - a. Review methods and procedures related to the preliminary construction schedule and Contractor's construction schedule, including, but not limited to, the following:
 - 1) Review software limitations and content and format for reports.
 - 2) Verify availability of qualified personnel needed to develop and update schedule.
 - 3) Discuss constraints, including phasing work stages area separations interim milestones and partial District occupancy.
 - 4) Review delivery dates for District-furnished products.
 - 5) Review schedule for work of District's separate contracts.
 - 6) Review submittal requirements and procedures.
 - 7) Review time required for review of submittals and resubmittals.
 - 8) Review requirements for tests and inspections by independent testing and inspecting agencies.
 - 9) Review District's IT requirements for installation of their Work.
 - 10) Review time required for Project closeout and District startup procedures, including commissioning activities for MEP, Security Electronics Equipment.
 - 11) Review and finalize list of construction activities to be included in schedule.
 - 12) Review procedures for updating schedule.
- C. At the meeting, the Construction Manager will review scheduling requirements. These include schedule preparation, reporting requirements, labor and equipment loading, updates, revisions, and schedule delay analysis.
 - 1. The Contractor will present schedule methodology, planned sequence of operations, resource loading methodology, and proposed activity coding structure.
- D. Coding structure:
 - 1. Submit proposed coding structure, identifying the code fields and the associated code values it intends to use in the project schedule.
 - 2. A minimum, include code fields for Project Segment or Phase, Area of Work, Type of Work, Submittal/Procurement/Construction and Responsibility/Subcontractor.
 - a. Refer to NETWORK DETAILS AND GRAPHICAL OUTPUT for listing of activity categories to be included in the schedule.

3.02 CONTENT

- A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.
- B. Identify each item by specification section number.
- C. Identify work of separate stages and other logically grouped activities.
 - 1. Identify Work of separate buildings, phases, units or other logically grouped activities to facilitate review of Application for Payment with completed Work.
- D. Provide sub-schedules for each stage of Work identified in Section 01 10 00 - Summary.
- E. Provide sub-schedules to define critical portions of the entire schedule.
- F. Include conferences and meetings in schedule.
- G. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.
- H. Provide separate schedule of submittal dates for shop drawings, product data, and samples, owner-furnished products, products identified under Allowances, and dates reviewed submittals will be required from Architect. Indicate decision dates for selection of finishes.
 - 1. Format: Prepare Submittals Schedule in a format comparable to Construction Progress Schedule, specified in Article above.
 - 2. Content: List all items specified to be submitted, indicating submittal number (see instructions specified in Section 01 30 00 - Administrative Requirements, submittal type (i.e., product data, shop drawings, sample, quality control report, maintenance and operating data, etcetera), scheduled date submittal is to be made and date review should be complete in order to maintain construction on schedule.
 - 3. The Contractor shall submit to the Architect a schedule of the shop drawings that lists their required submission and approval dates.
 - a. Allow minimum one (1) week for the Architect to review the submittals. Some submittals may require a longer review period. See Section 01 30 00 - Administrative Requirements.
 - b. Allow for the possibility that the consultant team will request revisions and resubmittal following the initial submittal.
 - c. The schedule shall encompass the entire construction period and will be revised by the Contractor and reviewed by the project team at each project meeting.
 - 4. Changes and Deviations: Identify all deviations from requirements of Drawings and Specifications.
 - a. Changes in the Work shall not be authorized by submittals review actions.
 - b. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
 - c. Changes shall only be authorized by separate written Change Order or Construction Change Directive, in accordance with the Conditions of the Contract and Section 01 20 00 - Price and Payment Procedures.
 - 5. Administration: Review of Submittals Schedules by Architect, Construction Manager, and District will be to ascertain the general status of submittals review and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.
 - a. Submit one copy each to Construction Manager and Architect.

- b. Submit initial Submittals Schedule within 14 days of construction start date established in Notice to Proceed.
 - c. After review, resubmit Submittals Schedule within 10 days and thereafter submit updated Submittals Schedules at each Construction Progress Meeting.
- I. Indicate delivery dates for owner-furnished products.
- J. Coordinate content with schedule of values specified in Section 01 20 00 - Price and Payment Procedures.
 - 1. Include Submittals Schedule.
- K. Provide legend for symbols and abbreviations used.

3.03 BAR CHARTS

- A. Include a separate bar for each major portion of Work or operation.
- B. Identify the first work day of each week.

3.04 NETWORK ANALYSIS

- A. Prepare network analysis diagrams and supporting mathematical analyses using the Critical Path Method.
- B. Illustrate order and interdependence of activities and sequence of work; how start of a given activity depends on completion of preceding activities, and how completion of the activity may restrain start of subsequent activities.
- C. Mathematical Analysis: Tabulate each activity of detailed network diagrams, using calendar dates, and identify for each activity:
 - 1. Preceding and following event numbers.
 - 2. Activity description.
 - 3. Estimated duration of activity, in maximum 15 day intervals.
 - 4. Project Milestones; include "Project Start" and "End Project" Milestones.
 - a. Schedule starts no earlier than the Project Duration (Day 1) will start on the Notice To Proceed (NTP) date.
 - 5. Earliest start date.
 - 6. Earliest finish date.
 - 7. Actual start date.
 - a. "Project Start" Milestone to have no predecessors and "End Project" Milestone has no successors.
 - b. "Project Start": Constrained by a "Mandatory Start" Milestone.
 - c. "End Project": Constrained by a "Mandatory Finish" Milestone.
 - d. No other activities on the schedule may have constraints, unless reviewed and approved by Construction Manager and Architect.
 - 8. Actual finish date.
 - 9. Latest start date.
 - 10. Latest finish date.
 - 11. Total and free float; float time shall accrue to District and to District's benefit.
 - a. Contractor does not own the float.

- b. "Float time" refers to the time between earliest finish date and the latest finish date of each activity shown on the Construction Schedule.
 - c. Any float time indicated in the Construction Schedules required by this Section are to be held jointly by the District and Contractor.
 - d. Any delay (including District caused) encountered is to be subtracted from the available days ahead of progress against the Construction Schedule.
 - 1) District may claim float days equal to the delay until such float days are exhausted.
 - 2) No compensation of any type will be due the Contractor until the delay extends the overall project Final Inspection date.
 - e. Weather (Rain) day requirements are as specified in the "Construction Services Agreement."
- 12. Monetary value of activity, keyed to Schedule of Values.
 - 13. Percentage of activity completed.
 - 14. Responsibility.
- D. Analysis Program: Capable of compiling monetary value of completed and partially completed activities, accepting revised completion dates, and recomputation of all dates and float.
- E. Required Reports: List activities in sorts or groups:
- 1. By preceding work item or event number from lowest to highest.
 - 2. By amount of float, then in order of early start.
 - 3. Contractor's periodic payment request sorted by Schedule of Values listings.
 - 4. Listing of activities on the critical path.

3.05 CREW SCHEDULES

- A. Separate and concurrent with the Baseline Schedule, submit a schedule histogram depicting crew loading for Contractor's own labor forces and those of each subcontractor. Submit this crew schedule electronically.
- B. Provide the breakdown of a typical crew, by trade, for resource loading quantification.

3.06 WEATHER DAYS ALLOWANCE- AS ANTICIPATED BY THE CONTRACTOR

- A. Based on historical weather in the local area, the Baseline Schedule shall include all non-work days on which the Contractor anticipates Work will not be performed due to adverse weather days that are anticipated to occur within the work day calendar and impact critical activities.
- B. The Contractor shall not receive any additional compensation for unavoidable delays due to inclement or unsuitable weather, and no time extension to complete any Contractual Completion Events as defined in General Conditions, will be considered due to inclement or unsuitable weather or conditions resulting there from.

3.07 REVIEW AND EVALUATION OF SCHEDULE

- A. Review all schedules reviewed and approved by Contractor prior to submission for review by Architect and District.
- B. Participate in joint review and evaluation of schedule with Construction Manager and Architect at each submittal.
- C. Evaluate project status to determine work behind schedule and work ahead of schedule.
- D. After review, revise as necessary as result of review, and resubmit within 10 days.

- E. Review by Architect and District will be to ascertain the general status of construction and shall not be interpreted to establish or approve the means, methods, techniques and sequences of construction.

3.08 SUMMARY SCHEDULE

- A. Provide Summary Schedule, upon request, which consolidates groups of activities associated with Major Items of Work shown on Baseline Schedule.
 - 1. Summary Schedule is intended to give an overall indication of the project schedule without a large amount of detail.
 - 2. This schedule shall include the current status of each of the contract Milestones listed in the Agreement, and any significant activities that are critical to the completion of the Milestone work at the required time.
- B. Include in the Summary Schedule a separate Gantt Chart depicting only the critical path of the project at the time of the update.
- C. Updated and submitted monthly and with each Schedule Update or Schedule Revision.

3.09 WEEKLY (SHORT TERM LOOK-AHEAD) SCHEDULE

- A. Submit to Construction Manager, twenty four (24) hours prior to each weekly progress meeting, a short term look ahead schedule showing the activities completed during the previous week and the schedule of activities for the following 4 weeks.
- B. Using the same computer software as the progress schedule, use the Activity ID's, Descriptions, and logic of the current progress schedule when producing a Weekly Schedule in CPM schedule or a bar chart format.
 - 1. In the event that the Weekly Schedule no longer conforms to the current schedule, Contractor may be required to revise either or both schedule(s).
- C. The activity designations used in the Weekly Schedule must be consistent with those used in the Baseline Schedule and the monthly Schedule Updates.
- D. Contractor and Construction Manager must agree on the format of the Weekly Schedule.
- E. Weekly Schedule should indicate locations of work, critical activities, early start and early finish dates, actual start and actual finish dates, progress, and remaining durations for each activity in the three-week schedule.

3.10 UPDATING SCHEDULE

- A. Maintain schedules to record actual start and finish dates of completed activities.
- B. Indicate progress of each activity to date of revision, with projected completion date of each activity.
- C. Annotate diagrams to graphically depict current status of Work.
- D. Identify activities modified since previous submittal, major changes in Work, and other identifiable changes.
- E. Indicate changes required to maintain Date of Final Completion.
- F. Submit reports required to support recommended changes.
- G. Provide narrative report to define problem areas, anticipated delays, and impact on the schedule. Report corrective action taken or proposed and its effect.

3.11 ADJUSTMENT OF CONTRACT TIMES

- A. Subject to the terms of General Conditions, contract time will be adjusted only for causes specified as generally described below.
1. Non-excusable delay:
 - a. Includes actions or inactions of the Contractor, or events for which the Contractor has assumed contractual responsibility that would independently delay the completion of the Work beyond the current Contract completion date.
 - 1) This also includes actions or inactions of subcontractors, suppliers, or material manufacturers at any tier.
 - b. No time extensions will be granted for non-excusable delays.
 2. Excusable delay:
 - a. Events which are unforeseeable, outside the control of, and without the fault or negligence of either the District or the Contractor (or any party for whom either is responsible), which would independently delay the completion of the Work beyond the current Contract completion date.
 - b. The Contractor is entitled to a time extension only.
 - c. No other damages will be approved.
 3. Compensable delay:
 - a. Actions or inactions of the District, or events for which the District has assumed contractual responsibility, which would independently delay the completion of the Work beyond the current Contract completion date.
 - b. The Contractor is entitled to a time extension and delay damages.
 4. Concurrent delay:
 - a. Any combination of the above three (3) types of delay occurring on the same calendar date, or cases where the combination consists of two (2) or more instances of the same type of delay occurring on the same calendar date.
 - 1) Exception to concurrent delay:
 - (a) When one cause of delay is District-caused or caused by an event which is beyond the control and without the fault or negligence of either the District or the Contractor and the other Contractor-caused, the Contractor is entitled only to a time extension and no delay damages.
- B. If the Contractor believes that the District has impacted its work, such that the project completion date will be delayed, the Contractor must submit proof demonstrating the delay to the critical path.
1. Proof, in the form of a Time Impact Analysis, may entitle the Contractor to an adjustment of Contract Time.
- C. Notify Construction Manager of a potential request for Contract Time adjustment within five (5) days of the start of the impact.
- D. The Contractor shall prepare and submit along with any Change Order Request (COR), response to Request for Proposal/Quote (RFP/RFQ), Differing Site Condition (DSC) notification or Request for Additional Compensation (RAC) a Time Impact Analysis (TIA) which includes both a written narrative and a schedule diagram depicting how the changed work may affect the progress of work and other schedule activities.
1. The schedule diagram shall show how the Contractor proposes to incorporate the changed work in the schedule, and how it impacts the current updated schedule and critical path.

2. The TIA shall not be resource constrained, or leveled using resource limits.
 3. Failure to include a TIA with the COR, Proposal, Quote, DSC or RAC shall constitute a waiver of the right to later claim any adjustment in time based upon changed or unforeseen Work.
- E. Time Impact Analysis (TIA):
1. Use the accepted schedule update that is current relative to the time frame of the delay event (change order, third party delay, or other District-caused delay). Represent the delay event in the schedule by:
 - a. Inserting new activities associated with the delay event into the schedule.
 - b. Revising activity logic.
 - c. Revising activity durations.
 2. If the project schedule's critical path and milestone date(s) are impacted as a result of adding this delay event to the schedule, a time extension equal to the magnitude of the impact without resource constraints may be warranted.
 3. The Time Impact Analysis submittal must include the following information:
 - a. A fragment of the portion of the schedule affected by the delay event.
 - b. A narrative explanation of the delay issue and how it impacted the schedule.
 - c. A digital file containing the schedule file used to perform the Time Impact Analysis.
- F. When a delay to the project as a whole can be avoided by revising preferential sequencing or logic, and the Contractor chooses not to implement the revisions, the Contractor will be entitled to a time extension and no compensation for extended overhead.
- G. Indicate clearly that the Contractor has used, in full, all project float available for the work involved in the request, including any float that may exist between the Contractor's planned completion date and the Contract completion date.
1. Utilize the latest version of the Schedule Update accepted at the time of the alleged delay, and all other relevant information, to determine the adjustment of the Contract Time.
- H. Adjustment of the Contract Times will be granted only when the Contract Float has been fully utilized and only when the revised date of completion of the Work has been pushed beyond the Contract completion date.
1. Adjustment of the Contract Times will be made only for the number of days that the planned completion of the work has been extended.
- I. Actual delays in activities which do not affect the critical path work or which do not move the Contractor's planned completion date beyond the Contract completion date will not be the basis for an adjustment to the Contract Time.
- J. Submit request as specified with Contract Documents.
1. In cases where the Contractor does not submit a request for Contract Time adjustment for a specific change order, delay, or Contractor request within the specified period of time, then it is mutually agreed that the particular change order, delay, or Contractor request has no time impact on the Contract completion date and no time extension is required.
- K. The Construction Manager will, within five (5) working days after receipt of a Contract Time adjustment, request any supporting evidence, review the facts, and advise the Contractor in writing.
1. Include the new Progress Schedule data, if accepted by the District, in the next monthly Schedule Update.

2. When the District has not yet made a final determination as to the adjustment of the Contract Time, and the parties are unable to agree as to the amount of the adjustment to be reflected in the Progress Schedule, reflect that amount of time adjustment in the Progress Schedule as the Construction Manager may accept as appropriate for such interim purpose.
 - a. It is understood and agreed that any such interim acceptance by the Construction Manager shall not be binding.
 - b. Interim acceptance shall be made only for the purpose of continuing to schedule the Work
 - c. Interim acceptance shall remain until such time as a final determination as to any adjustment of the Contract Time acceptable to the Construction Manager has been made.
 - d. Revise the Progress Schedule prepared thereafter in accordance with the final decision.

3.12 DISTRIBUTION OF SCHEDULE

- A. Distribute copies of updated schedules to Contractor's project site file, to Subcontractors, suppliers, Construction Manager, Architect, District, and other concerned parties.
- B. Posting: Post one copy, minimum, of most recent Construction and Submittals Schedules in the Contractor's jobsite office, readily available to Construction Manager and Architect.
- C. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.
- D. Archive: Preserve a minimum of two copies of all superseded schedules, with a minimum of one copy available at job office for review by Construction Manager or Architect.

3.13 FINAL SCHEDULE SUBMITTAL

- A. The final Schedule Update becomes the Record (As-Built) Schedule.
 1. The As-Built Schedule reflects the exact manner in which the project was constructed by reflecting actual logic, start and completion dates for all activities accomplished on the project.
 2. Contractor's Project Manager and Scheduler sign and certify the Record (As-Built) Schedule as being an accurate record of the way the project was actually constructed.
- B. Retainage will not be released until final Schedule Update is provided.

END OF SECTION

SECTION 01 35 50 REQUESTS FOR ELECTRONIC FILES

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Requirements to request electronic construction document files from Architect.
- B. Hold Harmless Agreement form.

1.02 RELATED SECTIONS

- A. Section 01 30 00 - Administrative Requirements: Shop Drawings, Product Data and Samples.
- B. Section 01 70 00 - Execution and Closeout Requirements.
- C. Divisions 31 through 33 - Site Work.

1.03 REQUIREMENTS

- A. Electronic files have legal ramifications as information therein can be modified.
- B. In order to receive this electronic information, the following Hold Harmless Agreement form must be executed in its entirety, including signature by a company officer.
- C. Costs for processing and handling electronic files, however limited, will be \$600.00

PART 2 - PRODUCTS - (NOT APPLICABLE TO THIS SECTION.)

PART 3 - EXECUTION

3.01 ELECTRONIC FILE TRANSFER PROCEDURE

- A. In order to expedite the transfer, upon receipt of a PDF copy of this acknowledgement, the requested CAD/Revit/BIM files will be sent in the form of a compact disc, DVD, or thumb drive to the recipient, as requested, by UPS, similar delivery service, or other method of electronic transfer after payment is received.
- B. It is expressly understood that any transfer is done as a courtesy and can be revoked at any time by the Architect.
Agreement is on next page

ARCHITECT'S PROJECT: BATTLES ES - TK-K BUILDING AND SITE UPGRADES

ARCHITECT'S PROJECT NUMBER: 75-24119-000

We, _____, understand that we may be receiving electronic media containing design information, not necessarily intended for construction. We agree to hold DLR Group harmless for any defects in this data. We agree that it shall be our responsibility to reconcile this electronic data with the paper plans, and that only the paper plans shall be regarded as legal documents for the referenced project.

Further, the Contractor acknowledges that the Architect's reports, drawings, specifications, field data, field notes, laboratory test data, calculations, estimates and other similar documents are instruments of professional service, not products. In accepting and utilizing any drawings or other data on any form of electronic media generated and provided by the Design Professionals, the Parties listed above covenant and agree that all such drawings and data are instruments of service of the Design Professionals, who shall be deemed the author of the drawings and data, and shall retain all common law, statutory law and other rights, including copyrights.

The Parties agree that in accepting and utilizing any drawings and other data, that the Design Professionals waive all responsibility for any subsequent use of these data, the accuracy of dimensions, and the interpretation of information contained herein.

The Parties further agree not to use these drawings and data, in whole or in part, for any purpose or project other than the project which is the subject of this Agreement. The Parties further agree to waive all claims against the Design Professionals resulting in any way from any unauthorized changes of the drawings and data or any other use other than for the project which is the subject of this Agreement.

The Contractor shall indemnify, defend and hold harmless the Design Professionals and its subconsultants and their officers, agents, employees from any claims, damages, losses, liabilities or expenses (including attorneys' fees) arising out of use of such documents without Consultant's prior written authorization.

Under no circumstances shall transfer of the drawings and other data be deemed a sale by the Design Professionals, and the Design Professionals make no warranties, either express or implied of the merchantability and fitness of the data for any particular purpose.

Sheet numbers or discipline requested: _____

Acknowledged by: Company Name _____

Signature of Company Officer Print or Type Name Date

Street Address _____

City, State, Zip Code _____

E-mail Address _____

END OF SECTION

SECTION 01 35 53 SECURITY PROCEDURES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Security measures including formal security program, entry control, personnel identification, and miscellaneous restrictions.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: use of premises and occupancy.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary lighting.

1.03 SECURITY PROGRAM

- A. Protect Work , existing premises and District's operations from theft, vandalism, and unauthorized entry.
- B. Initiate program in coordination with District's existing security system at project mobilization.
- C. Maintain program throughout construction period until District acceptance precludes the need for Contractor security.

1.04 ENTRY CONTROL

- A. Restrict entrance of persons and vehicles into Project site and existing facilities.
- B. Allow entrance only to authorized persons with proper identification.
- C. Maintain log of workers and visitors, make available to District on request.
- D. District will control entrance of persons and vehicles related to District's operations.
- E. Contractor shall control entrance of persons and vehicles related to District's operations.
- F. Coordinate access of District's personnel to site in coordination with District's security forces.

1.05 PERSONNEL IDENTIFICATION

- A. Shall be worn by Contractor's superintendent and all sub contractors
- B. Provide identification badge to each person authorized to enter premises.
- C. Badge To Include: Personal photograph, name, assigned number , expiration date and employer.
- D. Maintain a list of accredited persons, submit copy to District on request.
- E. Special badges shall be issued to construction personnel when term of construction exceeds six months.
- F. Require return of badges at expiration of their employment on the Work.

1.06 RESTRICTIONS

- A. Do not allow cameras on site or photographs taken except by written approval of District.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 40 00 QUALITY REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Contractor Quality assurance submittals.
- B. Quality assurance.
- C. Inspection agencies and services.
- D. Contractor's construction-related professional design services.
- E. Contractor's design-related professional design services.
- F. Control of installation.
- G. Mock-ups.
- H. Tolerances.
- I. Manufacturers' field services.
- J. Defect Assessment.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 41 00 - Regulatory Requirements: Compliance with applicable codes, ordinances and standards.
- C. Section 01 42 19 - Reference Standards.
- D. Section 01 45 33 - Code-Required Special Inspections: Testing laboratory services and inspections required by Division of the State Architect (DSA), during the course of construction.
- E. Section 01 60 00 - Product Requirements: Requirements for material and product quality.
 - 1. Product options, substitutions, transportation and handling requirements, storage and protection requirements, and system completeness requirements.

1.03 REFERENCE STANDARDS

- A. ASTM C1021 - Standard Practice for Laboratories Engaged in Testing of Building Sealants; 2008 (Reapproved 2023).
- B. ASTM C1077 - Standard Practice for Agencies Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Testing Agency Evaluation; 2024.
- C. ASTM C1093 - Standard Practice for Accreditation of Testing Agencies for Masonry; 2023.
- D. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- E. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- F. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- G. ASTM E699 - Standard Specification for Agencies Involved in Testing, Quality Assurance, and Evaluating of Manufactured Building Components; 2016.

H. IAS AC89 - Accreditation Criteria for Testing Laboratories; 2021.

1.04 DEFINITIONS

- A. Contractor's Quality Control Plan: Contractor's management plan for executing the Contract for Construction.

1.05 CONTRACTOR'S CONSTRUCTION-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Provide such engineering design services as may be necessary to plan and safely conduct certain construction operations, pertaining to, but not limited to the following:
1. Temporary sheeting, shoring, or supports.
 2. Temporary scaffolding.
 3. Temporary bracing.
 4. Temporary falsework for support of spanning or arched structures.
 5. Temporary stairs or steps required for construction access only.
 6. Temporary hoist(s) and rigging.
 7. Investigation of soil conditions to support construction equipment.

1.06 CONTRACTOR'S DESIGN-RELATED PROFESSIONAL DESIGN SERVICES

- A. Coordination: Contractor's professional design services are subject to requirements of project's Conditions for Construction Contract.
- B. Base design on performance and/or design criteria indicated in individual specification sections.
- C. Scope of Contractor's Professional Design Services: Provide for the following items of work:
1. Structural Design of Formwork: As described in Section 03 10 00 - Concrete Forming and Accessories.
 2. Concrete Mix Design: As described in Section 03 30 00 - Cast-in-Place Concrete. No specific designer qualifications are required.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Designer's Qualification Statement: Submit for Architect's knowledge as contract administrator, or for District's information.
1. Include information for each individual professional responsible for producing, or supervising production of, design-related professional services provided by Contractor.
 - a. Full name.
 - b. Professional licensure information.
 - c. Statement addressing extent and depth of experience specifically relevant to design of items assigned to Contractor.
- C. Quality Control Submittals Schedule
1. Schedule Format: Include quality control submittals on Submittals Schedule specified in accordance with General Conditions

2. Schedule Content: List all tests, inspections and reports specified to be submitted, indicating submittal number, submittal type (field test, field inspection, fabrication inspection, etcetera), scheduled date of quality control activity and date report should be made.
- D. Design Data: Submit for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for District's information.
 1. Include calculations that have been used to demonstrate compliance to performance and regulatory criteria provided, and to determine design solutions.
 2. Include required product data and shop drawings.
 3. Include a statement or certification attesting that design data complies with criteria indicated, such as building codes, loads, functional, and similar engineering requirements.
 4. Include signature and seal of design professional responsible for allocated design services on calculations and drawings.
- E. Test Reports: After each test/inspection, promptly submit two copies of report to Architect and to Contractor.
 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test/inspection.
 - h. Date of test/inspection.
 - i. Results of test/inspection.
 - j. Compliance with Contract Documents.
 - k. When requested by Architect, provide interpretation of results.
 2. Test report submittals are for Architect's knowledge as contract administrator for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents, or for District's information.
- F. Certificates: When specified in individual specification sections, submit certification by the manufacturer and Contractor or installation/application subcontractor to Architect, in quantities specified for Product Data.
 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect.
- G. Manufacturer's Instructions: When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, for the District's information. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
- H. Manufacturer's Field Reports: Submit reports for Architect's benefit as contract administrator or for District.

1. Submit report in duplicate within 30 days of observation to Architect for information.
 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
- I. Erection Drawings: Submit drawings for Architect's benefit as contract administrator or for District.
1. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in the Contract Documents.
 2. Data indicating inappropriate or unacceptable Work may be subject to action by Architect or District.

1.08 QUALITY ASSURANCE

- A. Testing Agency Qualifications:
1. Prior to start of work, submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Qualification Statement: Provide documentation showing testing laboratory is approved by Division of the State Architect.
 4. Qualification Statement: Provide documentation showing testing laboratory is accredited under IAS AC89.
- B. Designer Qualifications: Where professional engineering design services and design data submittals are specifically required of Contractor by Contract Documents, provide services of a Professional Engineer experienced in design of this type of work and licensed in California.
- C. Contractor's Quality Control (CQC) Plan:
1. Prior to start of work, submit a comprehensive plan describing how contract deliverables will be produced. Tailor CQC plan to specific requirements of the project. Include the following information:
 - a. Management Structure: Identify personnel responsible for quality. Include a chart showing lines of authority.
 - 1) Include qualifications (in resume form), duties, responsibilities of each person assigned to CQC function.
 - b. Management Approach: Define, describe, and include in the plan specific methodologies used in executing the work.
 - 1) Management and control of documents and records relating to quality.
 - 2) Communications.
 - 3) Coordination procedures.
 - 4) Resource management.
 - 5) Process control.
 - 6) Inspection and testing procedures and scheduling.
 - 7) Control of noncomplying work.
 - 8) Tracking deficiencies from identification, through acceptable corrective action, and verification.
 - 9) Control of testing and measuring equipment.

- 10) Project materials certification.
 - 11) Managerial continuity and flexibility.
 - c. District will not make a separate payment for providing and maintaining a Quality Control Plan. Include associated costs in Bid price.
 - d. Acceptance of the plan is required prior to start of construction activities not including mobilization work. District's acceptance of the plan will be conditional and predicated on continuing satisfactory adherence to the plan. District reserves the right to require Contractor to make changes to the plan and operations, including removal of personnel, as necessary, to obtain specified quality of work results.
- D. Quality-Control Personnel Qualifications. Engage a person with requisite training and experience to implement and manage quality assurance (QA) and quality control (QC) for the project.

1.09 REFERENCES AND STANDARDS - SEE SECTION 01 42 19

1.10 REGULATORY REQUIREMENTS FOR TESTING AND INSPECTION

- A. Inspections, testing and approvals as required by authorities having jurisdiction. Refer to Section 01 41 00 - Regulatory Requirements and Section 01 45 33 - Code-Required Special Inspections.
- B. Standards and Code Compliance and Manufacturer's Instructions and Recommendations: Unless more stringent requirements are indicated or specified, comply with manufacturer's instructions and recommendations, reference standards and building code research report requirements in preparing, fabricating, erecting, installing, applying, connecting and finishing Work.
- C. Deviations from Standards and Code Compliance and Manufacturer's Instructions and Recommendations: Document and explain all deviations from reference standards and building code research report requirements and manufacturer's product installation instructions and recommendations, including acknowledgement by the manufacturer that such deviations are acceptable and appropriate for the Project.

1.11 TESTING AND INSPECTION AGENCIES AND SERVICES

- A. District will employ and pay for services of an independent testing agency approved by DSA to perform specified testing.
- B. As indicated in individual specification sections, District or Contractor shall employ and pay for services of an independent testing agency to perform specified testing.
- C. Employment of agency in no way relieves Contractor of obligation to perform Work in accordance with requirements of Contract Documents.
- D. Contractor Employed Agency:
 - 1. Testing agency: Comply with requirements of ASTM E329, ASTM E543, ASTM E699, ASTM C1021, ASTM C1077, ASTM C1093, ASTM D3740, and DSA.
 - 2. Laboratory Qualifications: Accredited by IAS according to IAS AC89.
 - 3. Laboratory: Authorized to operate in California.
 - 4. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
 - 5. Testing Equipment: Calibrated at reasonable intervals either by NIST or using an NIST established Measurement Assurance Program, under a laboratory measurement quality assurance program.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 CONTRACTOR'S QUALITY ASSURANCE

- A. Quality Requirements: Work shall be accomplished in accordance with quality requirements of the Drawings and Specifications, including, by reference, all Codes, laws, rules, regulations and standards. When no quality basis is prescribed, the quality shall be in accordance with the best accepted practices of the construction industry for the locale of the Project, for projects of this type.
- B. Quality Control Personnel: Contractor shall employ and assign knowledgeable and skilled personnel as necessary to perform quality control functions to ensure that the Work is provided as required.

3.02 CONTROL OF INSTALLATION

- A. Quality of Products: Unless otherwise indicated or specified, all products shall be new, free of defects and fit for the intended use.
- B. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- C. Comply with manufacturers' instructions, including each step in sequence.
- D. Should manufacturers' instructions conflict with Contract Documents, request clarification from Architect before proceeding.
- E. Comply with specified standards as minimum quality for the work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.
- F. Have work performed by persons qualified to produce required and specified quality.
- G. Verify that field measurements are as indicated on shop drawings or as instructed by the manufacturer.
- H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, and disfigurement.
- I. Quality of Installation: All Work shall be produced plumb, level, square and true, or true to indicated angle, and with proper alignment and relationship between the various elements.
- J. Protection of Existing and Completed Work: Take all measures necessary to preserve and protect existing and completed Work free from damage, deterioration, soiling and staining, until Acceptance by the District.
- K. Verification of Quality: Work shall be subject to verification of quality by District, or Architect in accordance with provisions of the General Conditions of the Contract.
 - 1. Contractor shall cooperate by making Work available for inspection by District, Architect or their designated representatives.
 - 2. Such verification may include mill, plant, shop, or field inspection as required.
 - 3. Provide access to all parts of the Work, including plants where materials or equipment are manufactured or fabricated.
 - 4. Provide all information and assistance as required, including that by and from subcontractors, installers, fabricators, materials suppliers and manufacturers, for verification of quality by District, or Architect.

5. Contract modifications, if any, resulting from such verification activities shall be governed by applicable provisions in the General Conditions.

3.03 MOCK-UPS

- A. Before installing portions of the Work where mock-ups are required, construct mock-ups in location and size indicated for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work. The purpose of mock-up is to demonstrate the proposed range of aesthetic effects and workmanship.
- B. Accepted mock-ups establish the standard of quality the Architect will use to judge the Work.
- C. Notify Architect fifteen (15) working days in advance of dates and times when mock-ups will be constructed.
- D. Provide supervisory personnel who will oversee mock-up construction. Provide workers that will be employed during the construction at Project.
- E. Tests shall be performed under provisions identified in this section and identified in the respective product specification sections.
- F. Assemble and erect specified items with specified attachment and anchorage devices, flashings, seals, and finishes.
- G. Obtain Architect's approval of mock-ups before starting work, fabrication, or construction.
 1. Architect will issue written comments within seven (7) working days of initial review and each subsequent follow up review of each mock-up.
 2. Make corrections as necessary until Architect's approval is issued.
- H. Architect will use accepted mock-ups as a comparison standard for the remaining Work.
- I. Where mock-up has been accepted by Architect and is specified in product specification sections to be removed, protect mock-up throughout construction, remove mock-up and clear area when directed to do so by Architect.
- J. Where possible salvage and recycle the demolished mock-up materials.

3.04 TOLERANCES

- A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with Contract Documents, request clarification from Architect before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

3.05 TESTING AND INSPECTION

- A. See individual specification sections for testing required.
- B. Testing Agency Duties:
 1. Test samples of mixes submitted by Contractor.
 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 3. Perform specified sampling and testing of products in accordance with specified standards.
 4. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 5. Promptly notify Architect and Contractor of observed irregularities or non-compliance of Work or products.

6. Perform additional tests and inspections required by Architect.
7. Submit reports of all tests/inspections specified.
- C. Limits on Testing/Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the Work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the Work.
- D. Contractor Responsibilities:
 1. Deliver to agency at designated location, adequate samples of materials proposed to be used that require testing, along with proposed mix designs.
 2. Cooperate with laboratory personnel, and provide access to the Work and to manufacturers' facilities.
 3. Provide incidental labor and facilities:
 - a. To provide access to Work to be tested/inspected.
 - b. To facilitate tests/inspections.
 - c. To provide for storage and curing of test samples.
 4. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing/inspection services.
 5. Employ services of an independent qualified testing laboratory and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 6. Arrange with District's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 7. Inspections and Tests by Authorities Having Jurisdiction:
 - a. Contractor shall cause all tests and inspections to be made for Work under this Contract, as required by Building Departments, Department of Public Works, Fire Department, Health Department and similar agencies having jurisdiction.
 - b. Excepted as specifically noted, scheduling, conducting and paying for such inspections shall be solely the Contractor's responsibility.
 8. Inspections and Tests by Serving Utilities:
 - a. Contractor shall cause all tests and inspections required by serving utilities to be made for Work under this Contract.
 - b. Scheduling, conducting and paying for such inspections shall be solely the Contractor's responsibility.
- E. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- F. Costs of re-testing required because of non-compliance with specified requirements are to be reimbursed to the District by the Contractor through a deductive change order, CAC 4-335(b).

3.06 MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.

1. Observer subject to approval of Architect.
 2. Observer subject to approval of District.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

3.07 FIELD QUALITY CONTROL SUBMITTALS

- A. Administration: Make all submittals to the Architect, unless otherwise directed.
- B. Submittal Identification: Identify each submittal by Specification Section number followed by a number indicating sequential submittal for that Section. Coordinate submittal numbers with submittals specified in Section 01 30 00 - Administrative Requirements.

1. Resubmittals shall use same number as original submittal, followed by a letter indicating sequential resubmittal.

03 30 00 - 1	First submittal for Section 03 30 00 - Cast in Place Concrete.
03 30 00 - 2	Second submittal for Section 03 30 00 - Cast in Place Concrete.
03 30 00 - 2A	Resubmittal of second submittal for Section 03 30 00 - Cast in Place Concrete.
03 30 00 - 2B	Second resubmittal of second submittal for Section 03 30 00 - Cast in Place Concrete.

- C. Project Identification: Title each submittal with Project name, submittal date and Architect's Project number.
- D. Copies: Provide PDF copies electronically transmitted or submit 6 copies, minimum, of reports of quality control reports on dry-process xerographic copies only.
- E. Contractor's Review:
1. Submittals shall be made in accordance with requirements specified herein and in individual Sections.
 2. Indicate clearly on each submittal the specified or referenced values for each quality control activity and the values obtained.
 3. Note clearly and sign each submittal certifying that reported quality control activity "Conforms" or "Does Not Conform".
- F. Changes and Deviations:
1. Identify all deviations from requirements of Drawings and Specifications.
 2. Changes in the Work shall not be authorized by submittals review actions.
 3. No review action, implicit or explicit, shall be interpreted to authorized changes in the Work.
 4. Changes shall only be authorized by separate written Change Order or Construction Change Directive, in accordance with the General Conditions and 01 20 00 - Price and Payment Procedures.
- G. Record Submittals: When record submittals are specified, submit three copies or sets only. Record submittals will not be reviewed but will be retained for historical and maintenance purposes.
- H. Unsolicited Submittals: Unsolicited submittals will be returned unreviewed.

3.08 ARCHITECT'S REVIEW

- A. General:

1. Submitted Report review by Architect and Architect's consultants shall be only for general conformance with the design concept and requirements based on the information presented.
 2. Neither Architect nor Architect's consultants shall verify submitted quality control data.
- B. Contract Requirements:
1. Review by Architect and Architect's consultants shall not relieve the Contractor from compliance with requirements of the Drawings and Specifications.
 2. Changes shall only be authorized by separate written Change Order or Construction Change Directive, in accordance with the General Conditions and 01 20 00 - Price and Payment Procedures.
- C. Observations by Architect and Architect's Consultants: Periodic and occasional observations of Work in progress will be made by Architect and Architect's consultants as deemed necessary to review progress of Work and general conformance with design intent.

3.09 DEFECT ASSESSMENT

- A. Replace Work or portions of the Work not conforming to specified requirements, at no change in Contract Sum or Contract Time.
- B. If, in the opinion of Architect, it is not practical to remove and replace the work, Architect will direct an appropriate remedy or adjust payment.
- C. Architect's Acceptance and Rejection of Work: Architect reserves the right to reject all Work not in conformance to the requirements of the Drawings and Specifications.
- D. Acceptance of Non-Conforming Work: Acceptance of non-conforming Work, without specific written acknowledgement and approval of the District, shall not relieve the Contractor of the obligation to correct such Work.
1. Acceptance of structurally related non-conforming work shall be submitted to DSA for review and approval.
- E. Contract Adjustment for Non-conforming Work:
1. Should Architect or District determine that it is not feasible or in District's interest to require non-conforming Work to be repaired or replaced, an equitable reduction in Contract Sum shall be made by agreement between District and Contractor.
 2. If equitable amount cannot be agreed upon, a Construction Change Directive will be issued and the amount in dispute resolved in accordance with applicable provisions of the General Conditions.
- F. Non-Responsibility for Non-Conforming Work: Architect and Architect's consultants disclaim any and all responsibility for Work produced not in conformance with the Drawings and Specifications.

END OF SECTION

SECTION 01 41 00 REGULATORY REQUIREMENTS

PART 1 GENERAL

1.01 AUTHORITY AND PRECEDENCE OF CODES, ORDINANCES AND STANDARDS

- A. Authority: All codes, ordinances and standards referenced in the Drawings and Specifications shall have the full force and effect as though printed in their entirety in the Specifications.
- B. Precedence:
 - 1. Where specified requirements differ from the requirements of applicable codes, ordinances and standards, the more stringent requirements take precedence.
 - 2. Where the Drawings or Specifications require or describe products or execution of better quality, higher standard or greater size than required by applicable codes, ordinances and standards, the Drawings and Specifications take precedence so long as such increase is legal.
 - 3. Where no requirements are identified in the Drawings or Specifications, comply with all requirements of applicable codes, ordinances and standards of authorities having jurisdiction.
- C. Applicable Codes, Laws and Ordinances: Refer also to Section 01 10 00 - Summary, regarding permits and licenses.
 - 1. Performance of the Work is be governed by all applicable laws, ordinances, rules and regulations of Federal, State and local governmental agencies and jurisdictions having authority over the Project, including accessibility requirements.
 - 2. Performance of the Work shall be accomplished in conformance with all rules and regulations of public utilities, utility districts and other agencies serving the development.
 - 3. Where such laws, ordinances, rules and regulations require more care or greater time to accomplish Work, or require better quality, higher standards or greater size of products, Work shall be accomplished in conformance to such requirements with no change to the Contract Time and Contract Sum, except where changes in laws, ordinances, rules and regulations occur subsequent to the execution date of the Agreement.
- D. Applicable Building Codes: References on the Drawings or in the Specifications to "code" or "building code" not otherwise identified shall mean the codes specified below, together with all additions, amendments, changes, and interpretations adopted by code authorities of the jurisdiction having authority over the Project.
- E. Performance of the Work shall meet or exceed the minimum regulatory requirements applicable to this project are summarized in this section, as adopted by Division of the State Architect:
 - 1. Part 1, Title 24 CCR - 2022 California Administrative Code.
 - 2. Part 2, Title 24 CCR - 2022 California Building Code (CBC); Volumes 1 and 2.
 - a. Based on ICC (IBC) - ICC International Building Code, 2021.
 - b. Effective dates of referenced standards are according to Chapter 35.
 - 3. Part 3, Title 24 CCR - 2022 California Electrical Code.
 - a. 2023 is current NFPA 70, use the CEC based on the NFPA 70-NEC 2020 edition as modified.
 - 4. Part 4, Title 24 CCR - 2022 California Mechanical Code (CMC).

- a. Based on IAPMO (UMC) - Uniform Mechanical Code, 2021.
- 5. Part 5, Title 24 CCR - 2022 California Plumbing Code (CPC).
 - a. Based on IAPMO (UPC) - Uniform Plumbing Code, 2021.
- 6. Part 6, Title 24 CCR - 2022 California Energy Code.
- 7. Part 8, Title 24 CCR - 2022 California Historical Building Code.
- 8. Part 9, Title 24 CCR - 2022 California Fire Code (CFC).
 - a. Based on ICC (IFC) - International Fire Code; 2021.
- 9. Part 10, Title 24 CCR - 2022 California Existing Buildings Code.
 - a. Based on ICC (IEBC) - ICC International Existing Buildings Code, 2021.
- 10. Part 11, Title 24 CCR - 2022 California Green Building Standards Code (CalGreen).
- 11. Part 12, Title 24 CCR - 2022 California Referenced Standards Code.
- 12. Title 19 CCR, Public Safety
- F. Erosion and Sedimentation Control Regulations:
 - 1. California Codes and Regulations; Title 24, California Building Code, Parts 1 & 2.
 - 2. State of California State Water Resources Control Board Regulations.
 - 3. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; current edition.
- G. Maintain on site during construction, a copy of California Codes and Regulations; Title 24, California Building Code, Parts 1 through 5.

1.02 SUMMARY OF REFERENCE STANDARDS

- A. Regulatory requirements applicable to this project are the following:
 - 1. For a list of applicable standards, including California amendments to the NFPA Standards, refer to CBC Chapter 35 and CFC Chapter 80.
- B. California Referenced Standards Code: Chapter 12-7-4 Fire Resistive Standards, for fire rated doors.
- C. National Fire Protection Association (NFPA): (Partial List of Applicable Standards)
 - 1. Reference CBC for applicable NFPA Standards - 2022 CBC (SFM) Chapter 35.
 - 2. NFPA 72 - National Fire Alarm and Signaling Code (CA Amended); 2022, as amended in 2022 CBC Ch.35 Referenced Standards.
 - 3. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2019.
- D. 28 CFR 35 - Nondiscrimination on the Basis of Disability in State and Local Government Services; Final Rule; Department of Justice; current edition.
- E. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.
- F. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- G. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- H. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.

1.03 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 42 19 REFERENCE STANDARDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements relating to referenced standards.
- B. Reference standards full title and edition date.

1.02 QUALITY ASSURANCE

- A. For products or workmanship specified by reference to a document or documents not included in the Project Manual, also referred to as reference standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.
- B. Conform to reference standard of date of issue specified in the individual specification sections, except where a specific date is established by applicable code.
- C. Obtain copies of standards when required by Contract Documents.
- D. Maintain copy at project site during submittals, planning, and progress of the specific work, until Date of Final Inspection.
- E. Should specified reference standards conflict with Contract Documents, request clarification from the Architect before proceeding.
- F. Neither the contractual relationships, duties, or responsibilities of the parties in Contract nor those of the Architect shall be altered by Contract Documents by mention or inference otherwise in any reference document.

PART 2 CONSTRUCTION INDUSTRY ORGANIZATION DOCUMENTS

2.01 AAMA -- AMERICAN ARCHITECTURAL MANUFACTURERS ASSOCIATION

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.

2.02 ASTM A SERIES -- ASTM INTERNATIONAL

- A. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.

2.03 ASTM D SERIES -- ASTM INTERNATIONAL

- A. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- B. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

- C. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.

2.04 ASTM E SERIES -- ASTM INTERNATIONAL

- A. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- B. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007 (Reapproved 2019).

2.05 ASTM G SERIES -- ASTM INTERNATIONAL

- A. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2015, with Editorial Revision (2021).

2.06 CAL -- STATE OF CALIFORNIA

- A. CAL TITLE 24 P6 - California Code of Regulations, Title 24, Part 6 (California Energy Code); 2022.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- C. CAL (OSHA) TITLE 8 SC 7 - California Code of Regulations, Title 8, Subchapter 7, General Industry Safety Orders; 2021.
- D. CEC-500-2013-045 - Advanced Automated HVAC Fault Detection and Diagnostics Commercialization Program; 2008.

2.07 CARB -- CALIFORNIA AIR RESOURCES BOARD

- A. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; Current Edition.
- B. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

2.08 CALIFORNIA DEPARTMENT OF GENERAL SERVICES, DIVISION OF THE STATE ARCHITECT

- A. Interpretation of Regulations
 - 1. Document IR A-5 - Acceptance of Products, Materials, and Evaluations Reports; Revised 1-27-17 .
 - 2. Current listings are on the DGS website:
<http://www.dgs.ca.gov/dsa/Resources/IRManual.aspx>.

2.09 MPI -- MASTER PAINTERS INSTITUTE (MASTER PAINTERS AND DECORATORS ASSOCIATION)

2.10 NFPA -- NATIONAL FIRE PROTECTION ASSOCIATION

- A. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- B. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

2.11 SCAQMD -- SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

2.12 UL -- UNDERWRITERS LABORATORIES INC.

- A. UL (FRD) - Fire Resistance Directory; Current Edition.
- B. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

2.13 WCMA -- WINDOW COVERING MANUFACTURERS ASSOCIATION

- A. WCMA A100.1 - Standard for Safety of Window Covering Products; 2022.

PART 3 UNITED STATES GOVERNMENT AND RELATED AGENCIES DOCUMENTS

3.01 CFR -- CODE OF FEDERAL REGULATIONS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.
- C. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- D. 28 CFR 36 - Nondiscrimination by Public Accommodations and in Commercial Facilities; Final Rule; Department of Justice; current edition.
- E. 29 CFR 1910 - Occupational Safety and Health Standards; Current Edition.
- F. 29 CFR 1910, Subpart D - Walking-Working Surfaces, 1910.21-1910.30; Current Edition.
- G. 29 CFR 1910.23 - Ladders; Current Edition.
- H. 29 CFR 1910.38 - Emergency action plans; Current Edition.
- I. 29 CFR 1910.132-138 - Personal Protective Equipment; Current Edition.
- J. 29 CFR 1910.134 - Respiratory protection; Current Edition.
- K. 29 CFR 1926.62 - Lead; current edition.
- L. 29 CFR 1926.1101 - Asbestos; Current Edition.
- M. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- N. 39 CFR 111 - U.S. Postal Service Standard 4C; Current Edition.
- O. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- P. 40 CFR 60 - Standards of Performance for New Stationary Sources; Current Edition.
- Q. 40 CFR 273 - Standards For Universal Waste Management; current edition.
- R. 40 CFR 280 - Technical Standards and Corrective Action Requirements for Owners and Operators of Underground Storage Tanks; current edition.
- S. 40 CFR 761 - Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution In Commerce, And Use Prohibitions; current edition.
- T. 47 CFR 15 - Radio Frequency Devices; current edition.
- U. 47 CFR 68 - Connection of Terminal Equipment to the Telephone Network; Current Edition .
- V. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- W. 49 CFR 178 - Specifications for Packaging; current edition.
- X. 49 CFR 192.285 - Plastic Pipe: Qualifying Persons to Make Joints; current edition.

3.02 CPSC -- CONSUMER PRODUCTS SAFETY COMMISSION

- A. CPSC Pub. No. 325 - Public Playground Safety Handbook; 2015.

3.03 EPA -- ENVIRONMENTAL PROTECTION AGENCY

- A. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.
- B. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.
- C. EPA 600-4-790-20 - Methods for Chemical Analysis of Water and Wastes; 1983.
- D. EPA 625/1-86/021 - Design Manual: Municipal Wastewater Disinfection; 1986.
- E. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999, with Addendum (2000).
- F. EPA 712-C-02-190 - Health Effects Test Guidelines OPPTS 870.1100 Acute Oral Toxicity; 2021, with Addendum (2022).

3.04 FDA -- FOOD AND DRUG ADMINISTRATION

- A. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.

3.05 FEMA -- U.S. FEDERAL EMERGENCY MANAGEMENT AGENCY

- A. FEMA (MAPS) - FEMA Map Service Center; Current Edition.
- B. FEMA 412 - Installing Seismic Restraints for Mechanical Equipment; 2014.
- C. FEMA 413 - Installing Seismic Restraints for Electrical Equipment; 2004.
- D. FEMA 414 - Installing Seismic Restraints for Duct and Pipe; 2004.
- E. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage; 2012.

3.06 FS -- FEDERAL SPECIFICATIONS AND STANDARDS (GENERAL SERVICES ADMINISTRATION)

- A. FED-STD-595C - Colors Used in Government Procurement (Fan Deck); 2008 (Chg Notice 1).
- B. FS L-F-001641 - Floor Covering Translucent or Transparent Vinyl Surface with Backing; 1971, and Amendment 2, 1982.
- C. FS L-S-125 - Screening, Insect, Nonmetallic; 1972b, with Notice (1987).
- D. FS RR-P-1352 - Partitions, Toilet, Complete; Revision C, 1989.
- E. FS RR-T-650 - Treads, Metallic and Nonmetallic, Skid Resistant; 1994e.
- F. FS RR-W-365 - Wire Fabric (Insect Screening); 1980, Rev. A (Amended 1986).
- G. FS SS-T-312 - Tile, Floor: Asphalt, Rubber, Vinyl, and Vinyl Composition; Revision B, 1974, and Amendment 1, 1979.
- H. FS TT-B-1325 - Beads (Glass Spheres) Retro-Reflective; 2007d (Validated 2017).
- I. FS TT-P-115 - Paint, Traffic (Highway, White and Yellow); Revision F, 1984.
- J. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne; 2015f (Validated 2020).
- K. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; 2013e, with Amendments (2022).
- L. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h, with Amendments (2017).

- M. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2014g, with Amendment (2017).
- N. STATE STD 01.01 - Certification Standard Forced Entry and Ballistic Resistance of Structural Systems; Physical Security Division, Office of Physical Security Programs, Bureau of Diplomatic Security, United States Department of State; 1993.
- O. UFC 4-010-01 - DoD Minimum Antiterrorism Standards for Buildings; 2018, with Editorial Revision (2022).
- P. USPS Handbook AS-503 - Standard Design Criteria; United States Postal Service; 2010.

3.07 GSA -- U.S. GENERAL SERVICES ADMINISTRATION

- A. GSA PBS-P100 - Facilities Standards for the Public Buildings Service; 2024.

3.08 NIJ -- NATIONAL INSTITUTE OF JUSTICE (DEPT. OF JUSTICE)

- A. NIJ 0108.01 - Standard for Ballistic Resistant Protective Materials; 1985.

3.09 PS -- PRODUCT STANDARDS

- A. PS 1 - Structural Plywood; 2023.
- B. PS 2 - Performance Standard for Wood Structural Panels; 2018.
- C. PS 20 - American Softwood Lumber Standard; 2021.

3.10 USDA -- UNITED STATES DEPARTMENT OF AGRICULTURE

- A. USDA TR-55 - Urban Hydrology for Small Watersheds; USDA Natural Resources Conservation Service; 2015.

3.11 USGS -- UNITED STATES GEOLOGICAL SURVEY

- A. USGS (FMWQ) - National Field Manual for the Collection of Water-Quality Data; United States Geological Survey; current edition.

END OF SECTION

SECTION 01 45 33 CODE-REQUIRED SPECIAL INSPECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Division of the State Architect (DSA) Procedures for construction oversight and inspections required during the course of construction.
- B. Code-required special inspections.
 - 1. Division of the State Architect (DSA) approved testing laboratory services and inspections required during the course of construction.
- C. Testing services incidental to special inspections.
- D. Submittals.
- E. Manufacturers' field services.
- F. Fabricators' field services.

1.02 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Project Information: Soil investigation data.
- B. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- C. Section 01 40 00 - Quality Requirements.
- D. Section 01 42 19 - Reference Standards.
- E. Section 01 42 19 - Reference Standards: See also CBC Chapter 35 for current code adopted editions.
- F. Section 01 60 00 - Product Requirements: Requirements for material and product quality.

1.03 DEFINITIONS

- A. Code or Building Code: California Building Code and, more specifically, Chapter 17A - Structural Tests and Special Inspections, of same.
- B. Authority Having Jurisdiction (AHJ): Agency or individual officially empowered to enforce the building, fire and life safety code requirements of the permitting jurisdiction in which the Project is located. AHJ for this Project is Division of the State Architect.
- C. Special Inspection:
 - 1. Special inspections are inspections and testing of materials, installation, fabrication, erection or placement of components and connections mandated by the CBC that also require special expertise to ensure compliance with the approved contract documents and the referenced standards.
 - 2. Special inspections are separate from and independent of tests and inspections conducted by District or Contractor for the purposes of quality assurance and contract administration.

1.04 REFERENCE STANDARDS

- A. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- B. AISC 341 - Seismic Provisions for Structural Steel Buildings; 2022.

- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- E. ASTM A706/A706M - Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement; 2022a.
- F. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete; 2020.
- G. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field; 2024.
- H. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete; 2017.
- I. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- J. 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 (Reapproved 2021).
- K. ASTM D3740 - Standard Practice for Minimum Requirements for Agencies Engaged in Testing and/or Inspection of Soil and Rock as Used in Engineering Design and Construction; 2023.
- L. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- M. ASTM E543 - Standard Specification for Agencies Performing Nondestructive Testing; 2021.
- N. ASTM E2570/E2570M - Standard Test Methods for Evaluating Water-Resistive Barrier (WRB) Coatings Used Under Exterior Insulation and Finish Systems (EIFS) or EIFS with Drainage; 2007 (Reapproved 2019).
- O. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- P. AWS D1.3/D1.3M - Structural Welding Code - Sheet Steel; 2018, with Errata (2022).
- Q. AWS D1.4/D1.4M - Structural Welding Code - Steel Reinforcing Bars; 2018, with Amendment (2020).
- R. CAC - Part 1, Title 24 CCR - California Administrative Code; Current adopted edition.
- S. CBC - California Building Code; Current Adopted Edition.
- T. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.
- U. CBC Chapter 35 - CBC Chapter 35 - Referenced Standards; Current adopted edition.
- V. DSA IR 17-13 - Batch Plant Inspection; Current Adopted Edition.
- W. DSA PR 13-01 - Construction Oversight Process; Current adopted edition.
- X. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.
- Y. TMS 402/602 - Building Code Requirements and Specification for Masonry Structures; 2022, with Errata (2024).
- Z. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections; 2020.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Special Inspection Agency Qualifications: Prior to the start of work, the Special Inspection Agency is required to:

1. Submit agency name, address, and telephone number, names of full time registered Engineer and responsible officer.
 2. Submit copy of report of laboratory facilities inspection made by NIST Construction Materials Reference Laboratory during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.
 3. Submit certification that Special Inspection Agency is acceptable to AHJ.
- C. Testing Agency Qualifications: Prior to the start of work, the Testing Agency is required to:
1. Submit agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.
 2. Submit certification that Testing Agency is acceptable to AHJ.
 3. Testing and inspections will be performed by an independent testing laboratory selected and employed by the District and approved by the Division of the State Architect (DSA).
 - a. Qualification of a testing agency or laboratory will be under the jurisdiction of the DSA Structural Safety Section (SSS). Procedural and acceptance criteria are set forth in the California Administrative Code (CBC) Chapter 4.
- D. Manufacturer's Qualification Statement: Manufacturer is required to submit documentation of manufacturing capability and quality control procedures. Include documentation of AHJ approval.
- E. Fabricator's Qualification Statement: Fabricator is required to submit documentation of fabrication facilities and methods as well as quality control procedures.
- F. Distribution List: The Testing Laboratory will make the following distribution of test and inspection reports:
- 1 District
 - 2 Architect
 - 1 Structural Engineer
 - 1 Contractor
 - 1 District's Project Inspector
 - 1 Division of the State Architect
- G. Each and every test or inspection report shall bear the File Number and Application Number assigned to this project by the DSA.
- H. DSA Form 291: From the engineering manager of the laboratory of record.
- I. Special Inspection Reports: After each special inspection, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one each to the distribution list.
1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of special inspection.
 - h. Date of special inspection.

- i. Results of special inspection.
 - j. Compliance with Contract Documents.
 2. Final Special Inspection Report: Document special inspections and correction of discrepancies prior to the start of the work.
 3. Comply with DSA IR 17-12, revised 04/23/20.
- J. Fabricator Special Inspection Reports: After each special inspection of fabricated items at the Fabricator's facility, Special Inspector is required to promptly submit at least two copies of report; one to Architect and one each to the distribution list.
 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of Special Inspector.
 - d. Date and time of special inspection.
 - e. Identification of fabricated item and specification section.
 - f. Location in the Project.
 - g. Results of special inspection.
 - h. Verification of fabrication and quality control procedures.
 - i. Compliance with Contract Documents.
 - j. Compliance with referenced standard(s).
- K. Test Reports: After each test or inspection, promptly submit at least two copies of report; one to Architect and one each to the distribution list.
 1. Include:
 - a. Date issued.
 - b. Project title and number.
 - c. Name of inspector.
 - d. Date and time of sampling or inspection.
 - e. Identification of product and specifications section.
 - f. Location in the Project.
 - g. Type of test or inspection.
 - h. Date of test or inspection.
 - i. Results of test or inspection.
 - j. Compliance with Contract Documents.
 - k. Test reports shall be signed by a Civil Engineer licensed in the State of California.
 2. Test reports shall include all tests made, regardless of whether such tests indicate that the material is satisfactory or unsatisfactory.
 - a. Samples taken but not tested shall also be reported.
 - b. Records of special sampling operations as required shall also be reported.
 - c. Reports shall show that the material or materials were sampled and tested in accordance with the requirements of the CBC, and with the approved specifications.
 - d. They shall also state definitely whether or not the material or materials tested comply with requirements.

- e. Test reports shall be issued within 14 days of finding being known, to all parties listed above.
- 3. At the completion of the project, Testing Laboratory shall certify in writing and on all required DSA forms, that all work specified or required to be tested and inspected conforms to drawings, specifications and applicable building codes.
- 4. Verification of Test Reports:
 - a. The Testing Laboratory of record shall submit to the Division of the State Architect (DSA) a verified report covering all tests which are required to be made by that agency during the progress of the project.
 - 1) Such report shall be furnished each time that work on the project is suspended, covering the tests up to that time, and at the completion of the project.
 - 2) Specific testing requirements as listed on the Structural Test and Inspections (T&I) Form DSA-103 for this project. These tests may include the following forms:
 - (a) DSA-201: Soils Compaction.
 - (b) DSA-202: Sieve Analysis.
 - (c) DSA-203: Tension/Bend.
 - (d) DSA-204: Compression.
 - (e) DSA-206: Anchor Load.
 - (f) DSA-208: High-Strength Bolt.
 - (g) DSA-210: Ultrasonic (NDT).
 - (h) DSA-250: Special Inspection(s).
 - (i) DSA-291: Laboratory Verified Report.
 - (j) DSA-292: Special Inspection(s) Verified Report(s).
 - (k) DSA-293: Geotechnical Verified Report.
 - (l) DSA-403: Energy Compliance Checklist.
 - 3) Other Division of the State Architect (DSA) Certification Documents (Reports) as may be required.
 - b. DSA Form 292 - Special Inspection Verified Report shall be from all special inspectors contracting directly and individually with the school board.
- L. Certificates: When specified in individual special inspection requirements, Special Inspector shall submit certification by the manufacturer, fabricator, and installation subcontractor to Architect and AHJ, in quantities specified for Product Data.
 - 1. Indicate material or product complies with or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
 - 2. Certificates may be recent or previous test results on material or product, but must be acceptable to Architect and AHJ.
- M. Manufacturer's Field Reports: Submit reports to Architect.
 - 1. Submit report in duplicate within 7 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.
- N. Fabricator's Field Reports: Submit reports to Architect and AHJ.
 - 1. Submit report in duplicate within 30 days of observation to Architect for information.
 - 2. Submit for information for the limited purpose of assessing compliance with information given and the design concept expressed in Contract Documents.

1.06 SPECIAL INSPECTION AGENCY

- A. District will employ services of a Special Inspection Agency to perform inspections and associated testing and sampling in accordance with ASTM E329 and required by the building code.
- B. The Special Inspection Agency may employ and pay for services of an independent testing agency to perform testing and sampling associated with special inspections and required by the building code.
- C. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.07 TESTING AND INSPECTION AGENCIES

- A. District is to employ services of an independent inspection and testing agency to perform observation, testing and sampling associated with special inspections including those not required by the building code. CAC
 - 1. Project Inspector and testing lab are employed by the District and approved by:
 - a. A/E of Record.
 - b. Structural Engineer (when applicable).
 - c. DSA.
- B. Employment of agency in no way relieves Contractor of obligation to perform work in accordance with requirements of Contract Documents.

1.08 QUALITY ASSURANCE

- A. Special Inspection Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
- B. Testing Agency Qualifications:
 - 1. Independent firm specializing in performing testing and inspections of the type specified in this section.
 - 2. Testing Agency must possess DSA LEA Program acceptance.
- C. Testing and inspection services which are performed shall be in accordance with requirements of the CBC, and as specified herein. Testing and inspection services shall verify that work meets the requirements of the Construction Documents.
- D. In general, tests and inspections for structural materials shall include all items enumerated on the Structural Tests and Inspections list for this project as prepared and distributed by the Architect.
- E. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document.

1.09 INSPECTION BY THE **DISTRICT**

- A. The District shall have the right to reject materials and workmanship which are defective, or to require their correction.
 - 1. Rejected workmanship shall be satisfactorily corrected and rejected materials shall be removed from the premises without charge to the District.
 - 2. If the Contractor does not correct such rejected work within a reasonable time, the District may correct such rejected work and charge the expense to the Contractor.

- B. Should it be considered necessary or advisable by the District at any time before final acceptance of the entire work to make an examination of work already completed by removing or tearing out the completed work; the Contractor shall on request promptly furnish necessary facilities, labor and materials.
 - 1. If such work is found to be defective in any respect due to fault of the Contractor or his subcontractor, he shall defray all expenses of such examinations and of satisfactory reconstruction. .
 - 2. If, however, such work is found to meet the requirements of the Contract, the additional cost of labor and material necessarily involved in the examination and replacement shall be allowed the Contractor.

1.10 DISTRICT'S INSPECTOR

- A. A Project Inspector (IOR) employed by the District and approved by Architect, Structural Engineer and DSA in accordance with the requirements of the California Building Code will be assigned to the work.
 - 1. Project Inspector duties are specifically defined in Title 24 CCR Part 1, California Administrative Code Section 4-342.
- B. The District's Inspector shall at all times have access for the purpose of inspection to all parts of the work and to the shops where the work is in preparation, and the Contractor shall at all times maintain proper facilities and provide safe access for such inspection.
- C. The work of construction in all stages of progress shall be subject to the personal continuous observation of the District's Inspector.
 - 1. The Contractor shall furnish the Inspector reasonable facilities for obtaining such information as may be necessary to keep him fully informed respecting the progress and manner of the work and the character of the materials.
 - 2. Inspection of the work shall not relieve the Contractor from any obligation to fulfill this Contract.
 - 3. Inspector of Record is required to work a normal 40 hour week on this project only. Any overtime required will be included in a deductive change order to the Contractor and subcontractor requiring the inspection.

1.11 PAYMENTS

- A. Costs of initial testing and inspection, except as specifically modified herein, or specified otherwise in technical sections, will be paid for by the District, providing such testing and inspection indicates compliance with Contract Documents. Initial tests and inspections are defined as the first tests and inspections as herein 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 District and backcharged to the Contractor.
- C. Additional tests and inspections not herein specified but requested by District or Architect, will be paid for by District, unless results of such tests and inspections are found to be not in compliance with Contract Documents, in which case the District 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 District and backcharged to the Contractor.
- E. Costs for tests or inspections which are required to correct deficiencies will be paid by the District and backcharged to the Contractor.

- F. Cost of testing which is required solely for the convenience of Contractor in his scheduling and performance of work will be paid by the District and backcharged to the Contractor.
- G. Overtime costs for testing and inspections performed outside the regular work day hours, including weekends and holidays, will be paid for by the District and backcharged to the Contractor. Such costs include overtime costs for the District's Inspector.
- H. Testing Laboratory shall separate and identify on the invoices, the costs covering all testing and inspections which are to be backcharged to the Contractor as specified above.
- I. Testing Laboratory shall furnish to District a cost estimate breakdown covering initial tests and inspections required by Contract Documents. Estimate shall include number of tests, man-hours required for tests, field and plant inspections, travel time, and costs.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 SCHEDULE OF SPECIAL INSPECTIONS, GENERAL

- A. Tests and inspections for the following are required in accordance with DSA 103 Form.
- B. Frequency of Special Inspections: Special Inspections are indicated as continuous or periodic.
 - 1. Continuous Special Inspection: Special Inspection Agency is required to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspection: Special Inspection Agency is required to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Tests and inspections for the following will be required in accordance with the current CBC, unless otherwise specified.

3.02 SPECIAL INSPECTIONS FOR STEEL CONSTRUCTION (CHAPTER 17A AND 22A)

- A. Structural Steel: Comply with quality assurance inspection requirements of CBC.
- B. Erection Inspection: Testing Laboratory will visually inspect bolted and field welded connections, perform such additional tests and inspections of field work as are required by the Architect and prepare test reports for the Architect's review.
- C. Inspect High Strength Bolt Installation per CBC 1705A.2.1, Table 1705A.2.1.
 - 1. Special inspection for high tension bolting will be provided by the Testing Laboratory. Inspection in accordance with RCSC (HSBOLT).
 - 2. Comply with DSA Interpretations:
 - a. IR 17-8: Sampling and Testing of High Strength Bolts, Nuts, and Washers; Revised 09/24/19.
 - b. IR 17-9: High-Strength Structural Bolting Inspection; Revised 09/24/19.
- D. Welding:
 - 1. Testing Laboratory will review welding procedure specifications as prepared by the fabricator.
 - 2. Structural Steel:
 - a. Inspect welding per CBC 1705A.2.5.
 - 1) Comply with DSA IR 17-3: Structural Welding Inspection; Revised 09/24/19.

- b. Complete and Partial Joint Penetration Groove Welds: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; continuous.
 - c. Multipass Fillet Welds: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; continuous.
 - d. Single Pass Fillet Welds Less than 5/16 inch Wide: Verify compliance with AWS D1.1/D1.1M and BHMA A156.31; periodic.
 - e. Plug and Slot Welds: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; continuous.
 - f. Single Pass Fillet Welds 5/16 inch or Greater: Verify compliance with AWS D1.1/D1.1M and AWS D1.8/D1.8M; continuous.
 - g. Floor and Roof Deck Welds: Verify compliance with AWS D1.3/D1.3M; continuous.
 - 3. Reinforcing Steel: Verify items listed below comply with AWS D1.4/D1.4M and ACI CODE-318, Section 26.6.
 - a. Provide continuous inspection of welding of reinforcing steel per CBC 1705A.3.1; Table 1705A.3, Item 2; 1903A.8.
 - 4. Ultrasonic Testing: All full penetration groove welds in material 5/16 inch or greater shall be subject to ultrasonic testing.
 - a. Defective welds shall be repaired and retested with ultrasonic equipment.
 - b. Initially, all multi-pass groove field welds shall be tested at the rate of 100 percent of each individual welder.
 - 1) If rejectable defects occur in less than 5 percent of the welds tested, the frequency of testing may be reduced to 25 percent.
 - 2) If the rate of rejectable defects increases to 5 percent or more, 100 percent testing shall be reestablished until the rate is reduced to less than 5 percent.
 - 3) The percentage of rejects shall be calculated for each welder independently.
 - c. When ultrasonic indications arising from the weld root can be interpreted as either a weld defect or the backing strip itself, the backing strip shall be removed at the expense of the Contractor, and if no root defect is visible, the weld shall be retested.
 - 1) If no defect is indicated on this retest, and no significant amount of the base and weld metal have been removed, no further repair or welding is necessary.
 - 2) If a defect is indicated, it shall be repaired at the Contractor's expense.
 - 5. Technician to calibrate ultrasonic instrumentation to evaluate the quality of the welds in accordance with AWS D1.1/D1.1M latest Edition.
 - 6. Should defects appear in welds tested, inspect repairs similarly at the Contractor's expense and at the direction of the Architect until satisfactory performance is assured.
 - 7. Other methods of inspection, for example, X-ray, gamma ray, magnetic particle, or dye penetrant, may be used on welds if felt necessary by the Architect.
- E. Corrections:
- 1. Correct deficiencies in structural steel work which inspections and test reports indicate to be not in compliance with the specified requirements.
 - 2. Perform additional tests required to reconfirm noncompliance of the original work and to show compliance of corrected work. Costs for all additional tests will be paid for by the District and backcharged to the Contractor.

3.03 SPECIAL INSPECTIONS FOR CONCRETE CONSTRUCTION (CHAPTER 17A AND 19A)

- A. Inspection:
 - 1. Job Site Inspection: CBC 1705A.3, 1705A.3.5 (Conc. Preplacement), 1705A.3.6 (Placing Record), and 1910A.
 - 2. Batch Plant or Weighmaster Inspection: CBC 1705.3.3.
 - a. Continuous or Periodic Batch Plant Inspection per DSA IR 17-13
- B. Reinforcing Steel, Including: Verify compliance with approved contract documents and ACI CODE-318, Sections 20.2, 25.2 through 25.7, and 26.6.
 - 1. Reinforcing Bars: CBC 1901A.6; 1910A.2.
 - 2. Tests:
 - a. Tests shall be performed before the delivery of steel to Project site. Steel not meeting specifications shall not be shipped to the Project.
 - b. Testing procedure shall conform to ASTM A615/A615M or ASTM A706/A706M.
 - c. Sample at the place of distribution, before shipment:
 - 1) 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.
 - 2) Mill analysis shall accompany report.
 - 3) 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.
 - 4) Tests on unidentified reinforcing steel will be paid by the District and backcharged to the Contractor.
 - 5) Samples shall include not fewer than 2 pieces, each 18 inches long, of each size and kind of reinforcing steel.
 - d. District's Inspector will inspect all reinforcement for concrete work for size, dimensions, locations and proper placement.
- C. Reinforcing Bar Welding: Verify compliance with AWS D1.4/D1.4M and ACI CODE-318, 26.6.4; continuous.
 - 1. Verify weldability of reinforcing bars other than those complying with ASTM A706/A706M; periodic.
 - 2. Inspect single-pass fillet welds, maximum 5/16 inch; periodic.
 - 3. Inspect all other welds; continuous.
 - 4. Reinforcing Bar Welding Inspection: CBC 1705A.3.1; Table 1705A.3, Item 2; 1903A.8.
- D. Anchors Cast in Concrete: Verify compliance with ACI CODE-318; periodic.
- E. Bolts Installed in Concrete: Where allowable loads have been increased or where strength design is used, verify compliance with approved Contract Documents and ICC-ES AC308 approved report prior to and during placement of concrete; continuous.
 - 1. Comply with CBC Section 1910A.5; Table 1705A.3, items 4a & 4b, ASCE 7, Section 13.4.
- F. Anchors Post-Installed in Hardened Concrete: Verify compliance with ACI CODE-318.

1. Comply with CBC Section 1910A.5; Table 1705A.3, items 4a & 4b, ASCE 7, Section 13.4.
 2. Adhesive Anchors: Verify horizontally or upwardly-inclined orientation installations resisting sustained tension loads - Section 17.8.2.4; continuous.
 3. Other Mechanical and Adhesive Anchors: Verify as per Chapter 17.8.2; periodic.
- G. Anchors Installed in Hardened Concrete: Verify compliance with ACI CODE-318; periodic.
- H. Design Mix: Verify plastic concrete complies with the design mix in approved contract documents and with CBC Chapter 19A, ACI CODE-318, Sections 26.4.3, 26.4.4; periodic.
1. Portland Cement Tests: CBC 1705A.3.2, 1910A.1.
 2. Concrete Aggregates: CBC 1705A.3.2, 1903A.5.
 3. Batch Plant Inspection: CBC 1705A.3.3.
 4. Waiver of Continuous Batch Plant Inspection and Tests: CBC 1705A.3.3.1.
 5. Admixtures: CBC 1910A.1.
 6. Proportions of Concrete: CBC 1904A (Durability) and 1905A (Modifications to ACI CODE-318).
- I. Concrete Sampling Concurrent with Strength Test Sampling: Each time fresh concrete is sampled for strength tests, verify compliance with ASTM C172/C172M, ASTM C31/C31M, and ACI CODE-318, Chapter 26.5, 26.12, and record the following, continuous:
1. Slump.
 2. Air content.
 3. Temperature of concrete.
 4. Strength Tests of Concrete: CBC 1905A.1.17; Table 1705A.3 Item 6; ACI CODE-318 Sec. 26.12.
- J. Concrete Placement: Verify application techniques comply with approved Contract Documents and ACI CODE-318, Chapter 26.5; continuous.
- K. Specified Curing Temperature and Techniques: Verify compliance with ACI CODE-318, Chapter 26.5.3-26.5.5; continuous.
- L. Formwork Shape, Location and Dimensions: Verify compliance with approved Contract Documents and ACI CODE-318, Chapter 26.11.1.2(b); continuous.
- M. Welding of Reinforcing Bars: Conduct special inspections and verify Special Inspector's qualifications in accordance with requirements of AWS D1.4/D1.4M.
- N. District Inspector (IOR) will do the following:
1. Inspect placing of reinforcing steel and concrete at Project.
 2. Obtain weighmaster's certificate and identify mix before accepting each load.
 3. Keep daily record of concrete placement, identifying each truck load, time of receipt, and location of concrete in structure.
 4. Keep record until completion of Project and make available for inspection by DSA Field Engineer or representative.
 5. See also subparagraph on Waiver of Continuous Batch Plant Inspection above.
 6. During progress of work, take an additional number of test cylinders as directed by Architect. Conform to CBC 1905A.1.17 (modified ACI CODE-318). Test cylinders need not be made for concrete used in exterior flatwork.

- a. ACI CODE-318 Section 26.12.2.1 shall be replaced and the Contractor shall comply with the following:
 - 1) Samples for strength test of each class of concrete placed each day shall not be taken less than once for each 50 cubic yards (38.3m³) of concrete, or not less than once for each 2,000 square feet (186 m²) of surface area of for slabs or walls.
 - 2) Additional samples for seven day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.
7. One set of cylinders shall consist of 4 samples all taken from same batch, one to be tested at age of 7 days and two at 28 days.
8. Make and store cylinders according to ASTM C31/C31M.
9. Deliver cylinders to laboratory or store cylinders in a suitable protected environment for pick up by laboratory personnel.
10. Make slump test of wet concrete according to test for slump of portland cement concrete, ASTM C143/C143M, at least at the same frequency that the cylinders are taken.

3.04 SPECIAL INSPECTIONS FOR MASONRY CONSTRUCTION (CHAPTER 17A AND 21A)

- A. Masonry Structures Subject to Special Inspection:
 1. Masonry construction when required by the quality assurance program of TMS 402/602.
 2. Engineered masonry in structures classified as "low hazard..." and "substantial hazard to human life in the event of failure".
- B. Verify each item below complies with approved Contract Documents and the applicable articles of TMS 402/602.

1. Materials:

Masonry Units	CBC 2103A.1
Mortar, Portland Cement	CBC 2103A.2
Mortar and Grout Aggregates	CBC 2103A.3.1
Reinforcing Bars	CBC 2103A.4

2. Masonry Quality:

Portland Cement Tests	CBC 1903A, 1910A.1
Mortar and Grout Tests	CBC 2105A.3
Masonry Prism Tests	CBC 2105A.2
Masonry Core Tests	CBC 2105A.4
Masonry Unit Tests	CBC 2105A.2, 2105A.3, 1705A.4
Unit Strength Method Testing	CBC 2105A.2
Reinforcing Bar Tests	CBC 1910A.2

3. Masonry Inspection:

Reinforced Masonry	CBC 1705A.4; TMS 602 Tables 3 & 4, level 3
Reinforcing Bar Welding Inspection	CBC 1705A.3.1; Table 1705A.3, Item 2; 1903A.8
Post Installed Anchors in Masonry	CBC 1617A.1.19; 1705A.4, Table 1705A.3, Items 4a & 4b; 1910A.5

4. Inspections and Approvals:
 - a. Verify compliance with the required inspection provisions of the approved Contract Documents; periodic.
 - b. Verify approval of submittals required by Contract Documents; periodic.
5. Compressive Strength of Masonry: Verify compressive strength of masonry units prior to start of construction unless specifically exempted by code; periodic.
 - a. Comply with CBC 2105A.2 Compressive Strength.
6. Slump Flow and Visual Stability Index (VSI): Verify compliance as self consolidating grout arrives on site; continuous.
7. Joints and Accessories: When masonry construction begins, verify:
 - a. Proportions of site prepared mortar; periodic.
 - b. Construction of mortar joints; periodic.
 - c. Location of reinforcement, connectors, prestressing tendons, anchorages, etc; periodic.
8. Structural Elements, Joints, Anchors, Protection: During masonry construction, verify:
 - a. Size and location of structural elements; periodic.
 - b. Type, size and location of anchors, including anchorage of masonry to structural members, frames or other construction; periodic.
 - c. Size, grade and type of reinforcement, anchor bolts and prestressing tendons and anchorages; periodic.
 - d. Welding of reinforcing bars; continuous.
 - e. Preparation, construction and protection of masonry against hot weather above 90 degrees F and cold weather below 40 degrees F; periodic.
9. Grouting Preparation: Prior to grouting, verify:
 - a. Comply with CBC 2105A.2 Compressive Strength.
 - b. Grout space is clean; periodic.
 - c. Correct placement of reinforcing, connectors, prestressing tendons and anchorages; periodic.
 - d. Correctly proportioned site prepared grouts and prestressing grout for bonded tendons; periodic.
 - e. Correctly constructed mortar joints; periodic.
10. Preparation of Grout Specimens, Mortar Specimens and Prisms: Observe preparation of specimens; periodic.
 - a. Comply with CBC 2105A.2 Compressive Strength.

3.05 SPECIAL INSPECTIONS FOR SITE-BUILT WOOD CONSTRUCTION

- A. Conform to CBC 1705A.5.4 Wood Structural Elements and Assemblies.
- B. High Load Diaphragms: Verify compliance of each item below with approved Contract Documents.
 1. Grade and thickness of sheathing.
 2. Nominal size of framing members at adjacent panel edges.
 3. Nail or staple diameter and length.
 4. Number of fastener lines.

5. Fastener spacing at lines and at edges.

3.06 SPECIAL INSPECTIONS FOR SOILS

- A. Materials and Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
 1. Design bearing capacity of material below shallow foundations; periodic.
 2. Design depth of excavations and suitability of material at bottom of excavations; periodic.
 3. Materials, densities, lift thicknesses; placement and compaction of backfill: continuous.
 4. Subgrade, prior to placement of compacted fill verify proper preparation; periodic.
- B. Testing: Classify and test excavated material; periodic.
- C. Excavations, Foundations and Retaining Walls (Chapters 17A, 18A, and 33):
 1. Earth Compaction: CBC 1705A.6; Table 1705A.6, continuous; 1804A.6.
 2. Verify use of proper materials, densities, and lift thicknesses during placement and compaction of compacted fill: CBC 1705A.6.1; Table 1705A.6, periodic; 1804A.6.
- D. The Geotechnical Engineer of record or a Geotechnical Engineer selected by the District 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.
 1. The Geotechnical Engineer will submit a Verified Report indicating observations, tested fills, and opinion the fills were placed in accordance with the project specifications.
- E. Contractor shall remove unsatisfactory material, re-roll, adjust moisture, place new material, or in the case of excavations, provide proper protective measures, perform other operations necessary, as directed by the Geotechnical Engineer whose decisions and directions will be considered final.
- F. Soils Test and Inspection Procedure:
 1. Allow sufficient time for testing, and evaluation of results before material is needed. The Geotechnical 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 D1557.
 3. Field density tests will be made in accordance with ASTM D1556/D1556M.
 4. Number of tests will be determined by Geotechnical Engineer. Materials in question may not be used pending test results.
 5. Excavation and embankment inspection procedure. Geotechnical Engineer will visually or otherwise examine such areas for bearing values, cleanliness and suitability.
 6. Earthwork Test Reports: In order to avoid misinterpretations by the reviewing agencies, all retest results shall be reported on the same sheet, immediately following the previous failure test to which it is related. Retests shall be clearly noted as such.

3.07 SPECIAL INSPECTIONS FOR CAST-IN-PLACE DEEP FOUNDATIONS

- A. Materials, Equipment and Final Placement: Verify each item below complies with approved construction documents and approved geotechnical report.
 1. Element length; continuous.
 2. Element diameters and bell diameters; continuous.
 3. Embedment into bedrock; continuous.

4. End bearing strata capacity; continuous.
5. Placement locations and plumbness; continuous.
- B. Drilling Operations: Observe and maintain complete and accurate records for each element; continuous.
- C. Material Volume: Record concrete and grout volumes.
- D. Concrete Elements Associated with Cast-in-Place Deep Foundations: Perform additional inspections as required by the Special Inspections for Concrete Construction article of this section.

3.08 SPECIAL INSPECTIONS FOR SEISMIC RESISTANCE

- A. Inspection: Comply with CBC 1705A.13.
- B. Testing: Comply with CBC 1705A.13.
- C. Structural Steel: Comply with the quality assurance plan requirements of AISC 341.
- D. Structural Wood:
 1. Field gluing; continuous.
 2. Nailing, bolting, anchoring and other fastening of components within the seismic force-resisting system; periodic.
- E. Architectural Components: Erection and fastening of components below; periodic.
 1. Exterior cladding; per ICC ESR Report when applicable.
 2. Interior and exterior veneer.
 3. Interior and exterior non-loadbearing walls and partitions.
 4. Suspended ceiling systems and their anchorage, per ICC ESR Report. CBC Section 1705A.13.5 and 1705A.14.2.
- F. Mechanical and Electrical Components:
 1. Anchorage of electric equipment required for emergency or standby power systems; periodic.
 2. Installation and anchorage of other electrical equipment; periodic.
 3. Vibration isolation systems where the approved Contract Documents require a nominal clearance of 1/4 inch or less between support frame and seismic restraint; periodic.
 4. Installation of mechanical and electrical equipment, including duct work, piping systems and their structural supports, where automatic fire sprinkler systems are installed.
 - a. Verify clearances have been provide as required by Section 13.2.3 of ASCE 7.
 - b. Verify nominal clearance of 3 inches has been provided between fire protection sprinkler drops and sprigs and: structural members not used collectively or independently to support the sprinklers; equipment attached to the building structure; and other systems' piping.
- G. Designated Seismic System Verification: Verify label, anchorage or mounting complies with certificate of compliance provided by manufacturer or fabricator.
- H. Structural Testing for Seismic Resistance:
 1. Concrete reinforcement: Comply with ACI CODE-318, Section 20.2.2.5 and 21.1.52.
 - a. Materials Obtain mill certificates demonstrating compliance with ASTM A615/A615M; periodic.

- b. Welding: Perform chemical tests complying with ACI CODE-318, Section 26.6.4 to determine weldability; periodic.
 - 2. Structural Steel: Comply with the quality assurance requirements of AISC 341.
 - 3. Non-Structural Components:
 - a. General Design Requirements: Obtain manufacturer certification of compliance with requirements of ASCE 7, Section 13.2.1; periodic.
 - b. Designated Seismic Force-Resisting Non-Structural System Components: Obtain manufacturer certification of compliance with ASCE 7, Section 13.2.2; periodic.
- I. Structural Observations for Seismic Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.09 SPECIAL INSPECTIONS FOR WIND RESISTANCE

- A. Structural Wood:
 - 1. Field gluing of components in the main wind force-resisting system; continuous.
 - 2. Nailing, bolting, anchoring and other fastening of components within the main wind force-resisting system; periodic.
- B. Wind Resisting Components:
 - 1. Roof covering, roof deck, and floor framing connections; periodic.
 - 2. Exterior wall covering and wall connections to roof and floor diaphragms and framing; periodic.
- C. Structural Observations for Wind Resistance: Visually observe structural system for general compliance with the approved Contract Documents; periodic.

3.10 STRUCTURAL OBSERVATIONS FOR STRUCTURES

- A. Provide Observations: For structure where one or more of the following conditions exist:
 - 1. Such observation is required by the registered design professional responsible for the structural design.
 - 2. Such observation is specifically required by AHJ.

3.11 SPECIAL ARCHITECTURAL INSPECTIONS

- A. Signs and/or identification devices:
 - 1. Prior to issuance of a final Certificate of Occupancy, Enforcing Agency shall verify installation of signs for information content, appearance, location and Braille per CBC Chapter 11B-703.1.1.2.
 - a. Inspection shall include, but not limited to:
 - 1) Braille dots and cells are properly spaced and the size proportion and type raised characters are in compliance with these regulations.
 - 2) Tactile exit signage per CBC 1013.4 and 11B-216.4.1 Exit doors.
 - 3) Tactile floor designation signs in stairways per CBC 1023.9 Stairway identification signs.
 - 4) Elevator car control identification per CBC Chapter 11B-407.4.6-8 Elevator car controls.
 - 5) Sanitary facilities signage per CBC Chapter 11B-216.8 Toilet rooms and bathing rooms; and 11B-703.7.2.6 Toilet and bathing facilities geometric symbols.
- B. Water-resistive barrier coating:

1. Installation over sheathing substrate per ASTM E2570/E2570M.
- C. Glass and glazing identification:
 1. Verify installation of manufacturer's material mark inspection per CBC 2403.1.
 - a. Safety glazing shall be labeled per CBC 2406.3.
- D. Waterproofing Verification:
 1. The District's Inspector will check surfaces and approve before application of membrane materials and verify that substrate surfaces are in satisfactory condition to receive membrane materials and furnish continuous inspection during application of membrane.
 2. Check minimum specified thickness of membrane waterproofing. For fluid-applied membrane check thickness every 100 square feet during application with a mil-thickness gage especially manufactured for the purpose.

3.12 SPECIAL INSPECTION AGENCY DUTIES AND RESPONSIBILITIES

- A. Special Inspection Agency shall:
 1. Verify samples submitted by Contractor comply with the referenced standards and the approved Contract Documents.
 2. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 3. Perform specified sampling and testing of products in accordance with specified reference standards.
 4. Ascertain compliance of materials and products with requirements of Contract Documents.
 5. Promptly notify Architect, SEOR, IOR, DSA, District and Contractor of observed irregularities or non-conformance of work or products.
 6. Perform additional tests and inspections required by Architect.
 7. Attend preconstruction meetings and progress meetings.
 8. Submit reports of all tests or inspections specified.
- B. Limits on Special Inspection Agency Authority:
 1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the work.
- C. Re-testing required because of non-compliance with specified requirements shall be performed by the same agency on instructions by Architect.
- D. Re-testing required because of non-compliance with specified requirements shall be included in a deductive change order to the Contractor.
 1. CAC 4-335 (b).

3.13 TESTING AGENCY DUTIES AND RESPONSIBILITIES

- A. Testing Agency Duties:
 1. Provide qualified personnel at site. Cooperate with Architect and Contractor in performance of services.
 2. Perform specified sampling and testing of products in accordance with specified standards.

3. Ascertain compliance of materials and mixes with requirements of Contract Documents.
 4. Promptly notify Architect and Contractor of observed irregularities or non-compliance of work or products.
 5. Perform additional tests and inspections required by Architect.
 6. Attend preconstruction meetings and progress meetings.
 7. Submit reports of all tests or inspections specified.
- B. Limits on Testing or Inspection Agency Authority:
1. Agency may not release, revoke, alter, or enlarge on requirements of Contract Documents.
 2. Agency may not approve or accept any portion of the work.
 3. Agency may not assume any duties of Contractor.
 4. Agency has no authority to stop the work.
- C. Immediately upon determination of a test failure, the Laboratory shall telephone the results to the Architect. On the same day, Laboratory shall send test results by email to the Architect and to all relevant responsible parties of the project team, and District's Inspector
- D. On instructions by Architect, perform re-testing required because of non-compliance with specified requirements, using the same agency.
- E. Contractor will pay for re-testing required because of non-compliance with specified requirements by a deductive change order.
- F. At the completion of the project, Testing Laboratory shall certify in writing and on all required DSA forms, that all work specified or required to be tested and inspected conforms to drawings, specifications and applicable building codes.
1. See DSA Procedure PR 13-01.
- G. Duties of the Laboratory of Record related to the use of form DSA 152 are as follows:
1. Meet with the Project Inspector, design professionals, and contractor as needed to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.
 2. Obtain a copy of the DSA approved construction documents from the design professional in general responsible charge prior to the commencement of construction
 3. Obtain a copy of the DSA approved Statement of Structural Tests and Special Inspections (form DSA 103) from the design professional in general responsible charge prior to the commencement of construction.
 4. Report all project related activities to the Project Inspector. The Project Inspector is responsible for monitoring the work of the Laboratory of Record and Special Inspectors to ensure the testing and special inspection program is satisfactorily completed
 5. Provide material testing as identified in the DSA approved construction documents.
 6. Submit test reports to the Project Inspector on the day the tests were performed for any tests performed on-site
 7. Submit material test reports in a timely manner such that construction is not delayed and not to exceed 14 days from the date the material tests were performed. Test reports are to be submitted to DSA, the Architect, structural engineer, Project Inspector and school district.
 - a. As a convenience, and if agreed upon by involved parties, the test reports may be submitted electronically as identified in Section 4 of this procedure.

8. Immediately submit reports of material tests not conforming to the requirements of the DSA approved construction documents. These reports shall be submitted to the DSA, Architect, structural engineer, Project Inspector and school district.
 9. The Engineering Manager shall submit an interim Laboratory of Record Verified Report (form DSA 291) and the Geotechnical Engineer shall submit an interim Geotechnical Verified Report (form DSA 293) to DSA, the project inspector, school district and the Design Professional in General Responsible Charge.
 - a. The reports are required to be submitted upon any of the following events occurring:
 - 1) Within 14 days of the completion of the material testing/special inspection program.
 - 2) Work on the project is suspended for a period of more than one month.
 - 3) The services of the laboratory of record are terminated for any reason prior to completion of the project.
 - 4) The DSA requests a Verified Report. (See interim verified reports below. This is a "DSA request.")
 10. The Engineering Manager shall submit an interim verified report (form DSA 291) and the Geotechnical Engineer shall submit form DSA 293 to DSA and a copy to the project inspector for each of the applicable sections of the form DSA 152, prior to the project inspector signing off that section of the project inspection card, if that section required material testing. The sections are:
 - a. Initial Site Work
 - b. Foundation Prep
 - c. Vertical Framing
 - d. Horizontal Framing
 - e. Appurtenances
 - f. Finish Site Work
 - g. Other Work
 - h. Final
- H. Duties of Special Inspectors, employed by the Laboratory of Record, related to the use of form DSA 152 are as follows:
1. Meet with the Project Inspector, design professionals, and contractor as needed to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.
 2. Report all project related activities to the Project Inspector. The Project Inspector is responsible for monitoring the work of the Laboratory of Record and Special Inspectors to ensure the testing and special inspection program is satisfactorily completed.
 3. Perform work under the supervision of the Engineering Manager for the Laboratory of Record
 4. Perform inspections in conformance with the DSA approved construction documents, applicable codes and code reference standards
 5. Prepare detailed daily inspection reports outlining the work inspected and provide the Project Inspector a copy of the reports on the same day the inspections were performed.
 6. Prepare detailed daily inspection reports outlining the work inspected and provide the Project Inspector a copy of the reports on the same day the inspections were performed.

7. Immediately submit reports of materials or work not conforming to the requirements of the DSA approved construction documents. These reports shall be submitted to the DSA, Architect, structural engineer, Project Inspector and school district.
 8. Submit daily special inspection reports in a timely manner such that construction is not delayed and not to exceed 14 days from the date the special inspections were performed. The reports are to be submitted to the Architect, structural engineer, Project Inspector and school district.
 9. Submit Verified Report forms DSA 292 to the DSA, Project Inspector, district and design professional in responsible charge.
 10. The reports are required to be submitted upon any of the following events occurring:
 11. Within 14 days of the completion of the special inspection work.
 12. Work on the project is suspended for a period of more than one month.
 13. The services of the special inspector are terminated for any reason prior to completion of the project.
 14. The DSA requests a Verified Report. (See interim verified reports below. This is a “DSA request”)
 15. Submit an interim Verified Report (form DSA 292) to the DSA and a copy to the Project Inspector for each of the applicable sections of the form DSA 152, prior to the Project Inspector signing off that section of the project inspection card, if that section required special inspections. The sections are:
 - a. Initial Site Work
 - b. Foundation
 - c. Vertical Framing
 - d. Horizontal Framing
 - e. Appurtenances
 - f. Non-Building Site Structures
 - g. Finish Site Work
 - h. Other Work
 - i. Final
 16. The Verified Reports shall be sent electronically to the DSA.
- I. Duties of Special Inspectors, not employed by the Laboratory of Record, related to the use of form DSA 152 are as follows:
1. Meet with the project inspector, Laboratory of Record, the design professionals, and the contractors as needed to mutually communicate and understand the testing and inspection program, and the methods of communication appropriate for the project.
 2. Report all project related activities to the project inspector. The project inspector is responsible for monitoring the work of the Laboratory of Record and special inspectors to ensure the testing and special inspection program is satisfactorily completed.
 3. Perform work under the direction of the design professional in general responsible charge, as defined in Section 4-335(f)1B of the California Administrative Code (Title 24, Part 1).
 4. Perform inspections in conformance with the DSA approved construction documents, applicable codes and code reference standards.
 5. Prepare detailed daily inspection reports outlining the work inspected and provide the project inspector a copy of the reports on the same day the inspections were performed.

6. Immediately submit reports of materials or work not conforming to the requirements of the DSA approved construction documents. These reports shall be submitted to DSA, the Architect, structural engineer, project inspector and the school district.
7. Submit daily special inspection reports in a timely manner such that construction is not delayed and not to exceed 14 days from the date the special inspections were performed. The reports are to be submitted to DSA, the Architect, structural engineer, project inspector and the school district.
8. Submit Special Inspection Verified Report forms DSA 292 to DSA, the project inspector, the school district and the Design Professional in General Responsible Charge.
 - a. The reports are required to be submitted upon any of the following events occurring:
 - 1) Within 14 days of the completion of the special inspection work.
 - 2) Work on the project is suspended for a period of more than one month.
 - 3) The services of the special inspector are terminated for any reason prior to completion of the project.
 - 4) DSA requests a verified report. (See interim verified reports below. This is a "DSA request.")
9. Submit an interim Special Inspection Verified Report (form DSA 292) to DSA and a copy to the project inspector for each of the applicable sections of the form DSA 152, prior to the project inspector signing off that section of the project inspection card, if that section required special inspections.
 - a. The sections are:
 - 1) Initial Site Work
 - 2) Foundation Prep
 - 3) Vertical Framing
 - 4) Horizontal Framing
 - 5) Appurtenances
 - 6) Finish Site Work
 - 7) Other Work
 - 8) Final

3.14 CONTRACTOR DUTIES AND RESPONSIBILITIES

A. DSA Requirements:

1. Each Multi-Prime Contractor or Subcontractor shall comply with DSA Construction Oversight Procedure DSA PR 13-01. California Code of Regulations (CCR), Title 24, Part 1, CCR, Chapter 4, Article 1 (Sections 4-211 through 4-220) and Group 1, Articles 5 and 6 (Sections 4-331 through 4-344) which provide regulations governing the construction process for projects under the jurisdiction of the Division of the State Architect (DSA).
 - a. Assist the Project Inspector (IOR) and complete and fill out the following forms during the course of construction.
 - 1) Form-102-IC: Construction Start Notice/ Inspection Card Request: Verify Project Inspector has an active form issued by DSA.
 - 2) Form-151: Project Inspector Notifications: Contractor to notify IOR and assist.
 - 3) Form-152: Project Inspection Card: See below.

- 4) Form-154: Notice of Deviations/ Resolution of Deviations: Contractor to verify all deviations are reviewed, corrected, and accepted by the design professional, and filed with DSA through the Project Inspector (IOR).
 - (a) When the Project Inspector identifies deviations from the DSA approved construction documents the inspector must verbally notify the contractor. If the deviations are not corrected within a reasonable time frame, the inspector is required to promptly issue a written notice of deviation to the contractor, with a copy sent to the design professional in general responsible charge and the DSA.
 - (b) When the noticed deviations are corrected, the inspector is required to promptly issue a written notice of resolution to the contractor, with a copy sent to the design professional in general responsible charge and the DSA.
 - (c) Deviations include both construction deviations and material deficiencies.
 - (d) The written notice of deviations shall be made using form DSA 154.
 - (e) The notice of resolution of deviations shall be made using the original form DSA 154 that reported the deviations.
 - 5) Form-156: Commencement/Completion of Work Notification
 - 6) Form-6.C: Verified Report – Contractor: From each contractor having a contract with the school board.
2. Duties of Contractor related to the use of form DSA 152 are as follows:
 - a. The Contractor shall carefully study the DSA approved documents and shall plan a schedule of operations well ahead of time.
 - b. If at any time it is discovered that work is being done which is not in accordance with the DSA approved construction documents, the Contractor shall correct the work immediately.
 - c. Verify that forms DSA 152 are issued for the project prior to the commencement of construction.
 - d. Meet with the design team, the Laboratory of Record and the Project Inspector to mutually communicate and understand the testing and inspection program and the methods of communication appropriate for the project.
 - e. Notify the Project Inspector, in writing, of the commencement of construction of each and every aspect of the work at least 48 hours in advance by submitting form DSA 156 (or other agreed upon written documents) to the Project Inspector.
 - f. Notify the Project Inspector of the completion of construction of each and every aspect of the work by submitting form DSA 156 (or other agreed upon written documents) to the Project Inspector.
 - g. Consider the relationship of the signed off blocks and sections of the form DSA 152 and the commencement of subsequent work. Until the Project Inspector has signed off applicable blocks and sections of the form DSA 152, the Contractor may be prohibited from proceeding with subsequent construction activities that cover up the unapproved work. Any subsequent construction activities, that cover up the unapproved work, will be subject to a “Stop Work Order” from the DSA or the district and are subject to removal and remediation if found to be in non-compliance with the DSA approved construction documents.
 - h. Submit the final verified report. All prime contractors are required to submit final Contractor Verified Reports (form DSA 6-C) to DSA and the project inspector.

- 1) The reports are required to be submitted upon any of the following events occurring:
 - (a) The project is substantially complete. DSA considers the project to be complete when the construction is sufficiently complete in accordance with the DSA approved construction documents so that the owner can occupy or utilize the project.
 - (b) Work on the project is suspended for a period of more than one month.
 - (c) The services of the contractor are terminated for any reason prior to the completion of the project.
 - (d) DSA requests a verified report.
- B. Contractor Responsibilities, General:
 1. Deliver to agency at designated location, adequate samples of materials for special inspections that require material verification.
 2. Availability of Samples
 - a. Provide access to materials required for testing available to Laboratory and assist in acquiring these materials as directed by the District's Inspector. Samples shall only be taken under the immediate direction and supervision of the Testing Laboratory or District's Inspector.
 - b. If work which is required to be tested or inspected is covered up without prior notice or approval, such work may be uncovered at the discretion of Architect at no additional cost to the District. Refer to paragraph "Payments" herein.
 - c. Unless otherwise specified, Contractor shall notify Testing Laboratory a minimum of 10 working days in advance of all required tests, and a minimum of 2 working days in advance of all required inspections. All extra expenses resulting from a failure to notify the Laboratory will be paid by the District 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 District and backcharged to the Contractor.
 3. Cooperate with agency and laboratory personnel; provide access to approved documents at project site, to the work, to manufacturers' facilities, and to fabricators' facilities.
 4. Provide incidental labor and facilities:
 - a. To provide access to work to be tested or inspected.
 - b. To obtain and handle samples at the site or at source of Products to be tested or inspected.
 - c. To facilitate tests or inspections.
 - d. To provide storage and curing of test samples.
 5. Notify Architect and laboratory 24 hours prior to expected time for operations requiring testing or inspection services.
 6. Arrange with District's agency and pay for additional samples, tests, and inspections required by Contractor beyond specified requirements.
 7. The Contractor shall notify the District's Inspector a minimum of 5 working days in advance of the manufacture of material to be supplied by him under the Contract Documents, which must be by terms of the Contract be tested, in order that the District may arrange for the testing of such material at the source of supply.

8. Material shipped by the Contractor from the source of supply before having satisfactorily passed such testing and inspection or before the receipt of notice from said Inspector that such testing and inspection will not be required, shall not be incorporated in the Project.
 9. The District will select and pay testing laboratory costs for all tests and inspections, but may be reimbursed by the Contractor for such costs under the Contract conditions. Any direct payments by the Contractor to the testing laboratory on this project is prohibited.
- C. Contractor shall submit a written statement of responsibility to comply with CBC section 1704A.4.
1. Each contractor responsible for the construction of a main wind- or seismic-force-resisting system, designated seismic system or a wind- or seismic-resisting component listed in the statement of special inspections shall submit a written statement of responsibility to the building official and the owner prior to the commencement of work on the system or component. The contractor's statement of responsibility shall contain the following:
 - a. Acknowledgment of awareness of the special requirements contained in the statement of special inspections;
 - b. Acknowledgment that control will be exercised to obtain conformance with the construction documents approved by the building official;
 - c. Procedures for exercising control within the contractor's organization, the method and frequency of reporting and the distribution of the reports; and
 - d. Identification and qualifications of the person(s) exercising such control and their position(s) in the organization.
- D. Contractor Responsibilities, Seismic Force-Resisting System, Designated Seismic System, and Seismic Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and District prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.
- E. Contractor Responsibilities, Wind Force-Resisting System and Wind Force-Resisting Component: Submit written statement of responsibility for each item listed in the Statement of Special Inspections to AHJ and District prior to starting work. Statement of responsibility shall acknowledge awareness of special construction requirements and other requirements listed.
- F. Unless otherwise directed, materials not conforming to the requirements of Contract Documents shall be promptly removed from the Project site.

3.15 MANUFACTURERS' AND FABRICATORS' FIELD SERVICES

- A. When specified in individual specification sections, require material suppliers, assembly fabricators, or product manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, to test, adjust, and balance equipment as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Architect 30 days in advance of required observations.
 1. Observer subject to approval of Architect.
 2. Observer subject to approval of District.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

END OF SECTION

SECTION 01 50 00 TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary telecommunications services.
- B. Temporary sanitary facilities.
- C. Temporary Controls: Barriers, enclosures, and fencing.
- D. Security requirements.
- E. Waste removal facilities and services.

1.02 RELATED REQUIREMENTS

- A. Section 01 35 53 - Security Procedures
- B. Section 01 57 19 - Temporary Environmental Controls: Filtration requirements during construction and final cleaning.
- C. Section 01 58 13 - Temporary Project Signage.

1.03 TEMPORARY UTILITIES

- A. Provide and pay for all electrical power, lighting, water, heating and cooling, and ventilation required for construction purposes.
- B. Use trigger-operated nozzles for water hoses, to avoid waste of water.

1.04 TELECOMMUNICATIONS SERVICES

- A. Provide, maintain, and pay for telecommunications services to field office at time of project mobilization and duration of the project.
- B. Telecommunications services shall include:
 - 1. Windows-based personal computer dedicated to project telecommunications, with necessary software and laser printer.
 - a. Provide color copier with scanning capabilities and 8.5 x 11 and 11x17 format; including copier paper for both formats.
 - 2. Telephone Land Lines: Multiple lines, minimum; one handset per line.
 - 3. Internet Connections: Minimum of one for each desk; Cable modem (2GB) or faster.
 - a. Provide hi-speed INTERNET service in the District Construction Manager and Inspector field office for FOUR personnel; including copier/scanner.
 - 4. Facsimile Service: Minimum of one dedicated fax machine/printer, with dedicated phone line.

1.05 TEMPORARY SANITARY FACILITIES

- A. Provide and maintain required facilities and enclosures. Provide at time of project mobilization.
 - 1. Provide temporary toilet facilities if maximum number of personnel on project is greater than 10.
 - 2. Submit proposed location of temporary toilet(s) to Construction Manager for approval.

- a. Place on-site portable toilets away from building air intakes and entryway.
- B. Maintain daily in clean and sanitary condition.

1.06 BARRIERS

- A. Provide barriers to prevent unauthorized entry to construction areas, to prevent access to areas that could be hazardous to workers or the public, to allow for owner's use of site and to protect existing facilities and adjacent properties from damage from construction operations and demolition.
- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Protect non-owned vehicular traffic, stored materials, site, and structures from damage.

1.07 FENCING

- A. Construction: Commercial grade chain link fence. Include windscreen with galvanized steel schedule 40 post and top rail.
- B. Provide 6 foot high fence around construction site; equip with vehicular and pedestrian gates with locks.

1.08 EXTERIOR ENCLOSURES

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

1.09 SECURITY

- A. Provide security and facilities to protect Work, existing facilities, and District's operations from unauthorized entry, vandalism, or theft.
- B. Coordinate with District's security program.
 - 1. Include construction surveillance camera system per the District.

1.10 CAFETERIA AND FOOD

- A. Construction personnel shall police their own areas. All cups, cans, paper, wrappers, and discarded food must be placed in trash receptacles at end of each break.
- B. Contractor(s) shall submit to Construction Manager proposed location of any break areas and eating areas for approval.

1.11 SMOKING AND TOBACCO

- A. Smoking and vaping is not permitted on property.
- B. No chewing tobacco or spitting of tobacco is permitted.

1.12 VEHICULAR ACCESS AND PARKING

- A. Comply with regulations relating to use of streets and sidewalks, access to emergency facilities, and access for emergency vehicles.
- B. Coordinate access and haul routes with governing authorities and District.
- C. Provide and maintain access to fire hydrants, free of obstructions.
- D. Provide means of removing mud from vehicle wheels before entering streets.

- E. Provide temporary parking areas to accommodate construction personnel. When site space is not adequate, provide additional off-site parking.

1.13 WASTE REMOVAL

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Provide waste removal facilities and services as required to maintain the site in clean and orderly condition.
- C. Provide containers with lids. Remove trash from site periodically.
- D. If materials to be recycled or re-used on the project must be stored on-site, provide suitable non-combustible containers; locate containers holding flammable material outside the structure unless otherwise approved by the authorities having jurisdiction.
- E. Open free-fall chutes are not permitted. Terminate closed chutes into appropriate containers with lids.

1.14 PROJECT SIGNS - SEE SECTION 01 58 13

1.15 FIELD OFFICES

- A. Office: Weathertight, with lighting, electrical outlets, heating, cooling equipment, and equipped with sturdy furniture, drawing rack, and drawing display table.
- B. Provide space for Project meetings, with table and chairs to accommodate 6 persons.
- C. Provide separate private office similarly equipped and furnished, for use of District.
- D. Locate offices a minimum distance of 30 feet from existing and new structures.

1.16 REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

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

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 51 00 TEMPORARY UTILITIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary Utilities: Provision of electricity, lighting, heat, ventilation, and water.

1.02 RELATED REQUIREMENTS

- A. Section 01 50 00 - Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 TEMPORARY ELECTRICITY

- A. Cost: By Contractor.
- B. Provide power service required from utility source.
- C. Power Service Characteristics: 480 volt, 200 ampere, three phase, four wire.
- D. Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.
- E. Provide main service disconnect and over-current protection at convenient location and meter.
- F. Permanent convenience receptacles may be utilized during construction.
- G. Provide adequate distribution equipment, wiring, and outlets to provide single phase branch circuits for power and lighting.

1.05 TEMPORARY LIGHTING FOR CONSTRUCTION PURPOSES

- A. Provide and maintain LED, compact fluorescent, or high-intensity discharge lighting as suitable for the application for construction operations in accordance with requirements of 29 CFR 1926 and authorities having jurisdiction.
- B. Provide and maintain 1 watt/sq ft lighting to exterior staging and storage areas after dark for security purposes.
- C. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.
- D. Maintain lighting and provide routine repairs.
- E. Permanent building lighting may be utilized during construction.

1.06 TEMPORARY HEATING

- A. Cost of Energy: By Contractor.
- B. Provide heating devices and heat as needed to maintain specified conditions for construction operations.
- C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.

- D. Existing facilities shall not be used.
- E. Prior to operation of permanent equipment for temporary heating purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.07 TEMPORARY COOLING

- A. Cost of Energy: By Contractor.
- B. Provide cooling devices and cooling as needed to maintain specified conditions for construction operations.
- C. Maintain maximum ambient temperature of 80 degrees F in areas where construction is in progress, unless indicated otherwise in specifications.
- D. Existing facilities shall not be used.
- E. Prior to operation of permanent equipment for temporary cooling purposes, verify that installation is approved for operation, equipment is lubricated and filters are in place. Provide and pay for operation, maintenance, and regular replacement of filters and worn or consumed parts.

1.08 TEMPORARY VENTILATION

- A. Existing ventilation equipment may not be used.

1.09 TEMPORARY WATER SERVICE

- A. Cost of Water Used: By Contractor.
- B. Provide and maintain suitable quality water service for construction operations at time of project mobilization.
- C. Connect to existing water source.
 - 1. Exercise measures to conserve water.
- D. Extend branch piping with outlets located so water is available by hoses with threaded connections. Provide temporary pipe insulation to prevent freezing.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 01 52 13 FIELD OFFICES AND SHEDS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary field offices for use of Architect.
- B. Temporary field offices for use of Construction Manager.
- C. Temporary field offices for use of Project Inspector.
- D. Temporary field offices for use of Contractor.
- E. Maintenance and removal.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: use of premises and responsibility for providing field offices.
- B. Section 01 50 00 - Temporary Facilities and Controls:
 - 1. Temporary telecommunications services for administrative purposes.
 - 2. Temporary sanitary facilities required by law.
- C. Section 01 55 00: Parking and access to field offices.

1.03 USE OF EXISTING FACILITIES

- A. Existing facilities shall not be used for field offices.

1.04 USE OF PERMANENT FACILITIES

- A. Permanent facilities shall not be used for field offices.

PART 2 PRODUCTS

2.01 MATERIALS, EQUIPMENT, FURNISHINGS

- A. Materials, Equipment, Furnishings: Serviceable, new or used, adequate for required purpose.

2.02 CONSTRUCTION

- A. Portable or mobile buildings, or buildings constructed with floors raised above ground, securely fixed to foundations, with steps and landings at entrance doors.
- B. Construction: Structurally sound, secure, weather tight enclosures for office. Maintain during progress of Work; remove when no longer needed.
- C. Temperature Transmission Resistance of Floors, Walls, and Ceilings: Compatible with occupancy requirements.
- D. Exterior Materials: Weather resistant, finished in one color.
- E. Interior Materials in Offices: Sheet type materials for walls and ceilings, prefinished or painted; resilient floors and bases.
- F. Lighting for Offices: 50 fc at desk top height, exterior lighting at entrance doors.
- G. Fire Extinguishers: Appropriate type fire extinguisher at each office.

2.03 ENVIRONMENTAL CONTROL

- A. Heating, Cooling, and Ventilating: Automatic equipment to maintain comfort conditions.

2.04 CONTRACTOR OFFICE AND FACILITIES

- A. Size: For Contractor's needs and to provide space for project meetings.
- B. Telephone: As specified in Section 01 50 00.
- C. Furnishings in Meeting Area: Conference table and chairs to seat at least eight persons; racks and files for Contract Documents, submittals, and project record documents.
- D. Other Furnishings: Contractor's option.
- E. Equipment: Six adjustable band protective helmets for visitors, one 10 inch outdoor weather thermometer, rain gauge, and eye protection.

2.05 OWNER AND ARCHITECT/ENGINEER OFFICE

- A. Separate space for sole use of District and Architect, with separate entrance door with new lock and two keys.
- B. Windows: At least three, with minimum total area equivalent to 10 percent of floor area, with an operable sash and insect screen. Locate to provide views of construction area.
- C. Electrical Distribution Panel: Four circuits minimum, 110 volt, 60 hz service.
- D. Minimum for each 10 foot length, provide 110 volt duplex convenience outlets, on each wall of the office open space.
- E. Provide four 110 volt duplex convenience outlets in each office.
- F. Telephone: As specified in Section 01 50 00.
- G. Sanitary Facilities: As specified in Section 01 50 00.
- H. Drinking Fountain: Convenient access by workers.

PART 3 EXECUTION

3.01 PREPARATION

- A. Fill and grade sites for temporary structures to provide drainage away from buildings.

3.02 INSTALLATION

- A. Install office spaces ready for occupancy 15 days after date fixed in Notice to Proceed.
- B. Parking: Two hard surfaced parking spaces for use by District and Architect, connected to office by hard surfaced walk.

3.03 MAINTENANCE AND CLEANING

- A. Weekly janitorial services for offices; periodic cleaning and maintenance for offices.
- B. Maintain approach walks free of mud, water, and snow.

3.04 REMOVAL

- A. At completion of Work remove buildings, foundations, utility services, and debris. Restore areas.

END OF SECTION

SECTION 01 55 00 VEHICULAR ACCESS AND PARKING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Access roads.
- B. Parking.
- C. Existing pavements and parking areas.
- D. Permanent pavements and parking facilities.
- E. Construction parking controls.
- F. Flag persons.
- G. Flares and lights.
- H. Haul routes.
- I. Traffic signs and signals.
- J. Maintenance.
- K. Removal, repair.
- L. Mud from site vehicles.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: For access to site, work sequence, and occupancy.
- B. Section 01 58 13 - Temporary Project Signage: Post Mounted and Wall Mounted Traffic Control and Informational Signs.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Temporary Construction: Contractor's option.
- B. Materials for Permanent Construction: As specified in product specification sections, including earthwork, paving base, and topping.

2.02 SIGNS, SIGNALS, AND DEVICES

- A. Post Mounted and Wall Mounted Traffic Control and Informational Signs: Specified in Section 01 58 13 - Temporary Project Signage.
- B. Traffic Cones and Drums, Flares and Lights: As approved by local jurisdictions.
- C. Flag Person Equipment: As required by local jurisdictions.

PART 3 EXECUTION

3.01 PREPARATION

- A. Clear areas, provide surface and storm drainage of road, parking, area premises, and adjacent areas.

- B. Limit the number of haul trucks on site and establish a haul route. Install a gravel or base road on site for loading trucks. Haul route shall be reviewed and approved by Construction Manager and local jurisdictions, when on public roads.
- C. Provide a boundary/zone where equipment shall not enter because of proximity to active adjacent operation, and if necessary, equipment shall operate on alternative fuel to reduce diesel particulate matter.
- D. Establish construction site and access road speed limits and enforce them during the construction period.
- E. Restrict the hours of material transport to the periods and days permitted by both this contract and local noise or other applicable ordinance.
- F. Schedule haul trucks and material delivery trucks to prevent traffic congestion and impede the normal operation of the Facility. Set up truck queuing area away from public entrances.

3.02 ACCESS ROADS

- A. Use of existing on-site streets and driveways for construction traffic is permitted.
- B. Tracked vehicles not allowed on paved areas.
- C. Extend and relocate as work progress requires, provide detours as necessary for unimpeded traffic flow.
- D. Provide unimpeded access for emergency vehicles. Maintain 20 foot width driveways with turning space between and around combustible materials.
- E. Provide and maintain access to fire hydrants free of obstructions.

3.03 PARKING

- A. Use of designated areas of existing parking facilities by construction personnel is permitted.
 - 1. Construction Manager will meet with Contractor(s) to determine parking requirements.
- B. Construction Manager will notify security of parking area to be used by construction personnel if at variance with this procedure.
- C. Use of designated areas of new parking facilities by construction personnel is permitted.
- D. Contractor(s) and related personnel shall park in authorized areas only.
- E. Do not allow heavy vehicles or construction equipment in parking areas.
- F. Arrange for temporary parking areas to accommodate use of construction personnel.
- G. When site space is not adequate, provide additional off-site parking.

3.04 PERMANENT PAVEMENTS AND PARKING FACILITIES

- A. The base for permanent roads and parking areas may be used for construction traffic.
- B. Avoid traffic loading beyond paving design capacity. Tracked vehicles not allowed.

3.05 CONSTRUCTION PARKING CONTROL

- A. Control vehicular parking to prevent interference with public traffic and parking, access by emergency vehicles, and District's operations.
- B. Monitor parking of construction personnel's vehicles in existing facilities. Maintain vehicular access to and through parking areas.
- C. Prevent parking on or adjacent to access roads or in non-designated areas.

3.06 FLAG PERSONS

- A. Provide trained and equipped flag persons to regulate traffic when construction operations or traffic encroach on public traffic lanes.

3.07 FLARES AND LIGHTS

- A. Use flares and lights during hours of low visibility to delineate traffic lanes and to guide traffic.

3.08 HAUL ROUTES

- A. Consult with authority having jurisdiction, establish public thoroughfares to be used for haul routes and site access.
- B. Confine construction traffic to designated haul routes.
- C. Provide traffic control at critical areas of haul routes to regulate traffic, to minimize interference with public traffic.

3.09 TRAFFIC SIGNS AND SIGNALS

- A. At approaches to site and on site, install at crossroads, detours, parking areas, and elsewhere as needed to direct construction and affected public traffic.
- B. Relocate as work progresses, to maintain effective traffic control.

3.10 MAINTENANCE

- A. Maintain traffic and parking areas in a sound condition free of excavated material, construction equipment, products, mud, snow, and ice.
- B. Maintain existing paved areas used for construction; promptly repair breaks, potholes, low areas, standing water, and other deficiencies, to maintain paving and drainage in original, or specified, condition.

3.11 REMOVAL, REPAIR

- A. Remove underground work and compacted materials to a depth of 2 feet; fill and grade site as specified.
- B. Repair existing facilities damaged by use, to original condition.
- C. Remove equipment and devices when no longer required.
- D. Repair damage caused by installation.
- E. Remove post settings to a depth of 2 feet.

3.12 MUD FROM SITE VEHICLES

- A. Provide means of removing mud from vehicle wheels before entering streets.

END OF SECTION

SECTION 01 57 13 TEMPORARY EROSION AND SEDIMENT CONTROL (SWPP)

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Prevention of erosion due to construction activities.
- B. Prevention of sedimentation of waterways, open drainage ways, and storm and sanitary sewers due to construction activities.
- C. Restoration of areas eroded due to insufficient preventive measures.
- D. Performance bond.
- E. Compensation of District for fines levied by authorities having jurisdiction due to non-compliance by Contractor.

1.02 SUMMARY

- A. The Grading Prime Contractor is to file with the State of California, State Water Resources Control Board a Notice of Intent (N.O.I.) to comply with the terms of the General Permit to Discharge Storm Water Associated with Construction Activity, prior to the beginning of construction on this site.
 - 1. Prepare, implement, and monitor the Storm Water Pollution Prevention Plan (SWPPP) prepared for this site.
 - 2. It is required to review the storm water pollution prevention plan and to identify possible pollution sources and mitigation measures with all subcontractors at their starting of work on site.
- B. The Contractor will be obligated to comply with the requirements of the State's General Permit. Any fines or penalties due to failure to comply with the general permit shall be borne by the Contractor.
- C. Storm water pollution prevention plan testing and reporting will be performed by the Contractor until such responsibility is reassigned by the District.

1.03 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete for temporary and permanent erosion control structures indicated on drawings.
- B. Section 31 10 00 - Site Clearing: Limits on clearing; disposition of vegetative clearing debris.
- C. Section 31 22 00 - Grading: Temporary and permanent grade changes for erosion control.
- D. Section 32 11 23 - Aggregate Base Courses: Temporary and permanent roadways.

1.04 REFERENCE STANDARDS

- A. ASTM D4355/D4355M - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture, and Heat in a Xenon Arc-Type Apparatus; 2021.
- B. ASTM D4491/D4491M - Standard Test Methods for Water Permeability of Geotextiles by Permittivity; 2022.
- C. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).

- D. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- E. ASTM D4751 - Standard Test Methods for Determining Apparent Opening Size of a Geotextile; 2021a.
- F. ASTM D4873/D4873M - Standard Guide for Identification, Storage, and Handling of Geosynthetic Rolls and Samples; 2017 (Reapproved 2021).
- G. California Codes and Regulations; Title 24, California Building Code, Parts 1 & 2.
- H. State of California State Water Resources Control Board Regulations.
- I. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

1.05 PERFORMANCE REQUIREMENTS

- A. Comply with all requirements of U.S. Environmental Protection Agency for erosion and sedimentation control, as specified for the National Pollutant Discharge Elimination System (NPDES), Phases I and II, under requirements for the 2003 Construction General Permit (CGP).
- B. Also comply with all more stringent requirements of State of California Erosion and Sedimentation Control Manual.
- C. Comply with all requirements of WQMP for erosion and sedimentation control.
- D. Develop and follow an Erosion and Sedimentation Prevention Plan and submit periodic inspection reports.
- E. Do not begin clearing, grading, or other work involving disturbance of ground surface cover until applicable permits have been obtained; furnish all documentation required to obtain applicable permits.
 - 1. District will obtain permits and pay for securities required by authority having jurisdiction.
 - 2. District will withhold payment to Contractor equivalent to all fines resulting from non-compliance with applicable regulations.
- F. Provide to District a Performance Bond covering erosion and sedimentation preventive measures only, in an amount equal to 100 percent of the cost of erosion and sedimentation control work.
- G. Timing: Put preventive measures in place as soon as possible after disturbance of surface cover and before precipitation occurs.
- H. Storm Water Runoff: Control increased storm water runoff due to disturbance of surface cover due to construction activities for this project.
 - 1. Prevent runoff into storm and sanitary sewer systems, including open drainage channels, in excess of actual capacity or amount allowed by authorities having jurisdiction, whichever is less.
 - 2. Anticipate runoff volume due to the most extreme short term and 24-hour rainfall events that might occur in 25 years.
- I. Erosion On Site: Minimize wind, water, and vehicular erosion of soil on project site due to construction activities for this project.
 - 1. Control movement of sediment and soil from temporary stockpiles of soil.
 - 2. Prevent development of ruts due to equipment and vehicular traffic.

3. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to District.
- J. Erosion Off Site: Prevent erosion of soil and deposition of sediment on other properties caused by water leaving the project site due to construction activities for this project.
 1. Prevent windblown soil from leaving the project site.
 2. Prevent tracking of mud onto public roads outside site.
 3. Prevent mud and sediment from flowing onto sidewalks and pavements.
 4. If erosion occurs due to non-compliance with these requirements, restore eroded areas at no cost to District.
- K. Sedimentation of Waterways On Site: Prevent sedimentation of waterways on the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to District; remove deposited sediments; comply with requirements of authorities having jurisdiction.
 2. If sediment basins are used as temporary preventive measures, pump dry and remove deposited sediment after each storm.
- L. Sedimentation of Waterways Off Site: Prevent sedimentation of waterways off the project site, including rivers, streams, lakes, ponds, open drainage ways, storm sewers, and sanitary sewers.
 1. If sedimentation occurs, install or correct preventive measures immediately at no cost to District; remove deposited sediments; comply with requirements of authorities having jurisdiction.
- M. Open Water: Prevent standing water that could become stagnant.
- N. Maintenance: Maintain temporary preventive measures until permanent measures have been established.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Comply with pertinent provisions of the general permit.
- C. Erosion and Sedimentation Control Plan:
 1. Submit not less than 30 days prior to anticipated start of clearing, grading, or other work involving disturbance of ground surface cover.
 2. Include:
 - a. Site plan identifying soils and vegetation, existing erosion problems, and areas vulnerable to erosion due to topography, soils, vegetation, or drainage.
 - b. Measurements of existing turbidity of waterways.
 - c. Site plan showing grading; new improvements; temporary roads, traffic accesses, and other temporary construction; and proposed preventive measures.
 - d. Where extensive areas of soil will be disturbed, include storm water flow and volume calculations, soil loss predictions, and proposed preventive measures.
 - e. Schedule of temporary preventive measures, in relation to ground disturbing activities.
 - f. Other information required by law.
 - g. Format required by law is acceptable, provided any additional information specified is also included.

3. Obtain the approval of the Plan by authorities having jurisdiction.
4. Obtain the approval of the Plan by District.
- D. Certificate: Mill certificate for silt fence fabric attesting that fabric and factory seams comply with specified requirements, signed by legally authorized official of manufacturer; indicate actual minimum average roll values; identify fabric by roll identification numbers.
- E. Inspection Reports: Submit report of each inspection; identify each preventive measure, indicate condition, and specify maintenance or repair required and accomplished.
- F. Maintenance Instructions: Provide instructions covering inspection and maintenance for temporary measures that must remain after Final Inspection.

PART 2 PRODUCTS

2.01 NOT USED - REFER TO SWPP FOR MATERIALS.

2.02 MATERIALS

- A. Mulch: Use one of the following:
 1. Straw or hay.
 2. Wood waste, chips, or bark.
 3. Erosion control matting or netting.
 4. Cutback asphalt.
 5. Polyethylene film, where specifically indicated only.
- B. Grass Seed For Temporary Cover: Select a species appropriate to climate, planting season, and intended purpose. If same area will later be planted with permanent vegetation, do not use species known to be excessively competitive or prone to volunteer in subsequent seasons.
- C. Bales: Air dry, rectangular straw bales.
 1. Cross Section: 14 by 18 inches, minimum.
 2. Bindings: Wire or string, around long dimension.
- D. Bale Stakes: One of the following, minimum 3 feet long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Wood, 2 by 2 inches in cross section.
- E. Silt Fence Fabric: Polypropylene geotextile resistant to common soil chemicals, mildew, and insects; non-biodegradable; in longest lengths possible; fabric including seams with the following minimum average roll lengths:
 1. Average Opening Size: 30 U.S. Std. Sieve, maximum, when tested in accordance with ASTM D4751.
 2. Permittivity: 0.05 sec^{-1} , minimum, when tested in accordance with ASTM D4491/D4491M.
 3. Ultraviolet Resistance: Retaining at least 70 percent of tensile strength, when tested in accordance with ASTM D4355/D4355M after 500 hours exposure.
 4. Tensile Strength: 100 pounds-force, minimum, in cross-machine direction; 124 pounds-force, minimum, in machine direction; when tested in accordance with ASTM D4632/D4632M.
 5. Elongation: 15 to 30 percent, when tested in accordance with ASTM D4632/D4632M.

6. Tear Strength: 55 pounds-force, minimum, when tested in accordance with ASTM D4533/D4533M.
7. Color: Manufacturer's standard, with embedment and fastener lines preprinted.
8. Manufacturers:
 - a. TenCate: www.tencate.com.
 - b. North American Green: www.nagreen.com.
 - c. Propex Geosynthetics: www.geotextile.com
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Silt Fence Posts: One of the following, minimum 5 feet long:
 1. Steel U- or T-section, with minimum mass of 1.33 pound per linear foot.
 2. Softwood, 4 by 4 inches in cross section.
 3. Hardwood, 2 by 2 inches in cross section.
- G. Gravel: See Section 32 11 23 for aggregate.
- H. Riprap: See Section 31 37 00.
- I. Concrete: See Section 03 30 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine site and identify existing features that contribute to erosion resistance; maintain such existing features to greatest extent possible.
- B. Correct conditions detrimental to timely and proper completion of the work.
- C. Do not proceed until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Schedule work so that soil surfaces are left exposed for the minimum amount of time.

3.03 SCOPE OF PREVENTIVE MEASURES

- A. In all cases, if permanent erosion resistant measures have been installed temporary preventive measures are not required.
- B. Construction Entrances: Traffic-bearing aggregate surface.
 1. Width: As required; 20 feet, minimum.
 2. Length: 50 feet, minimum.
 3. Provide at each construction entrance from public right-of-way.
 4. Where necessary to prevent tracking of mud onto right-of-way, provide wheel washing area out of direct traffic lane, with drain into sediment trap or basin.
- C. Linear Sediment Barriers: Made of silt fences.
 1. Provide linear sediment barriers:
 - a. Along downhill perimeter edge of disturbed areas, including soil stockpiles.
 - b. Along the top of the slope or top bank of drainage channels and swales that traverse disturbed areas.
 - c. Along the toe of cut slopes and fill slopes.

- d. Perpendicular to flow across the bottom of existing and new drainage channels and swales that traverse disturbed areas or carry runoff from disturbed areas; space at maximum of 200 feet apart.
 - e. Across the entrances to culverts that receive runoff from disturbed areas.
 - 2. Space sediment barriers with the following maximum slope length upslope from barrier:
 - a. Slope of Less Than 2 Percent: 100 feet..
 - b. Slope Between 2 and 5 Percent: 75 feet.
 - c. Slope Between 5 and 10 Percent: 50 feet.
 - d. Slope Between 10 and 20 Percent: 25 feet.
 - e. Slope Over 20 Percent: 15 feet.
- D. Storm Drain Curb Inlet Sediment Trap: Protect each curb inlet using one of the following measures:
 - 1. Filter fabric wrapped around hollow concrete blocks blocking entire inlet face area; use one piece of fabric wrapped at least 1-1/2 times around concrete blocks and secured to prevent dislodging; orient cores of blocks so runoff passes into inlet.
 - 2. Straw bale row blocking entire inlet face area; anchor into pavement.
- E. Storm Drain Drop Inlet Sediment Traps: As detailed on drawings.
- F. Temporary Splash Pads: Stone aggregate over filter fabric; size to suit application; provide at downspout outlets and storm water outlets.
- G. Soil Stockpiles: Protect using one of the following measures:
 - 1. Cover with polyethylene film, secured by placing soil on outer edges.
 - 2. Cover with mulch at least 4 inches thickness of pine needles, sawdust, bark, wood chips, or shredded leaves, or 6 inches of straw or hay.
- H. Mulching: Use only for areas that may be subjected to erosion for less than 6 months.
 - 1. Wood Waste: Use only on slopes 3:1 or flatter; no anchoring required.
 - 2. Asphalt: Use only where no traffic, either vehicular or pedestrian, is anticipated.
- I. Temporary Seeding: Use where temporary vegetated cover is required.

3.04 INSTALLATION

- A. Installation of the work shall be as indicated on the Drawings as specified herein and regulatory requirements.
- B. Maintain the protection up to the project completion.
- C. Traffic-Bearing Aggregate Surface:
 - 1. Excavate minimum of 6 inches.
 - 2. Place geotextile fabric full width and length, with minimum 12 inch overlap at joints.
 - 3. Place and compact at least 6 inches of 1 1/2 to 3 1/2 inch diameter stone.
- D. Silt Fences:
 - 1. Store and handle fabric in accordance with ASTM D4873/D4873M.
 - 2. Where slope gradient is less than 3:1 or barriers will be in place less than 6 months, use nominal 16 inch high barriers with minimum 36 inch long posts spaced at 6 feet maximum, with fabric embedded at least 4 inches in ground.

3. Where slope gradient is steeper than 3:1 or barriers will be in place over 6 months, use nominal 28 inch high barriers, minimum 48 inch long posts spaced at 6 feet maximum, with fabric embedded at least 6 inches in ground.
 4. Where slope gradient is steeper than 3:1 and vertical height of slope between barriers is more than 20 feet, use nominal 32 inch high barriers with woven wire reinforcement and steel posts spaced at 4 feet maximum, with fabric embedded at least 6 inches in ground.
 5. Install with top of fabric at nominal height and embedment as specified.
 6. Embed bottom of fabric in a trench on the upslope side of fence, with 2 inches of fabric laid flat on bottom of trench facing upslope; backfill trench and compact.
 7. Do not splice fabric width; minimize splices in fabric length; splice at post only, overlapping at least 18 inches, with extra post.
 8. Fasten fabric to wood posts using one of the following:
 - a. Four nails per post with 3/4 inch diameter flat or button head, 1 inch long, and 14 gauge, 0.083 inch shank diameter.
 - b. Five staples per post with at least 17 gauge, 0.0453 inch wire, 3/4 inch crown width and 1/2 inch long legs.
 9. Fasten fabric to steel posts using wire, nylon cord, or integral pockets.
 10. Wherever runoff will flow around end of barrier or over the top, provide temporary splash pad or other outlet protection; at such outlets in the run of the barrier, make barrier not more than 12 inches high with post spacing not more than 4 feet.
- E. Straw Bale Rows:
1. Install bales in continuous rows with ends butting tightly, with one bale at each end of row turned uphill.
 2. Install bales so that bindings are not in contact with the ground.
 3. Embed bales at least 4 inches in the ground.
 4. Anchor bales with at least two stakes per bale, driven at least 18 inches into the ground; drive first stake in each bale toward the previously placed bale to force bales together.
 5. Fill gaps between ends of bales with loose straw wedged tightly.
 6. Place soil excavated for trench against bales on the upslope side of the row, compacted.
- F. Mulching Over Small and Medium Areas:
1. Dry Straw and Hay: Apply 4 to 6 inches depth.
 2. Wood Waste: Apply 2 to 3 inches depth.
 3. Asphalt: Apply 1/4 gallon per square yard.
 4. Erosion Control Matting: Comply with manufacturer's instructions.
- G. Temporary Seeding:
1. When hydraulic seeder is used, seedbed preparation is not required.
 2. When surface soil has been sealed by rainfall or consists of smooth undisturbed cut slopes, and conventional or manual seeding is to be used, prepare seedbed by scarifying sufficiently to allow seed to lodge and germinate.
 3. If temporary mulching was used on planting area but not removed, apply nitrogen fertilizer at 1 pound per 1000 sq ft.
 4. On soils of very low fertility, apply 10-10-10 fertilizer at rate of 12 to 16 pounds per 1000 sq ft.

5. Incorporate fertilizer into soil before seeding.
6. Apply seed uniformly; if using drill or cultipacker seeders place seed 1/2 to 1 inch deep.
7. Irrigate as required to thoroughly wet soil to depth that will ensure germination, without causing runoff or erosion.
8. Repeat irrigation as required until grass is established.

3.05 MAINTENANCE

- A. During and upon completion of the work comply with the general provisions of the general permit.
- B. Inspect preventive measures weekly, within 24 hours after the end of any storm that produces 0.5 inches or more rainfall at the project site, and daily during prolonged rainfall.
- C. Repair deficiencies immediately.
- D. Silt Fences:
 1. Promptly replace fabric that deteriorates unless need for fence has passed.
 2. Remove silt deposits that exceed one-third of the height of the fence.
 3. Repair fences that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- E. Straw Bale Rows:
 1. Promptly replace bales that fall apart or otherwise deteriorate unless need has passed.
 2. Remove silt deposits that exceed one-half of the height of the bales.
 3. Repair bale rows that are undercut by runoff or otherwise damaged, whether by runoff or other causes.
- F. Clean out temporary sediment control structures weekly and relocate soil on site.
- G. Place sediment in appropriate locations on site; do not remove from site.

3.06 CLEAN UP

- A. Remove temporary measures after permanent measures have been installed, unless permitted to remain by Architect.
- B. Clean out temporary sediment control structures that are to remain as permanent measures.
- C. Where removal of temporary measures would leave exposed soil, shape surface to an acceptable grade and finish to match adjacent ground surfaces.

END OF SECTION

SECTION 01 57 19 TEMPORARY ENVIRONMENTAL CONTROLS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Construction procedures to promote adequate indoor air quality after construction.
- B. Building flush-out after construction and before occupancy.
- C. Testing indoor air quality before commencement of construction; existing building areas only.
- D. Testing indoor air quality after completion of construction.
- E. Testing air change effectiveness after completion of construction.

1.02 PROJECT GOALS

- A. Dust and Airborne Particulates: Prevent deposition of dust and other particulates in HVAC ducts and equipment.
 - 1. Cover duct openings and protect mechanical equipment during construction. Provide tape, plastic, sheet metal or other methods acceptable to Construction Manager.
 - a. Comply with California Green Code Section 5.504.3.
 - 2. Cleaning of ductwork is not contemplated under this Contract.
 - 3. Contractor shall bear the cost of cleaning required due to failure to protect ducts and equipment from construction dust.
 - 4. Establish condition of existing ducts and equipment prior to start of alterations.
- B. Airborne Contaminants: Procedures and products have been specified to minimize indoor air pollutants.
 - 1. Furnish products meeting the specifications.
 - 2. Avoid construction practices that could result in contamination of installed products leading to indoor air pollution.

1.03 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Testing and inspection services.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary construction requirements.
- C. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- D. Section 01 91 13 - General Commissioning Requirements: Verification of installed Work and it's performance.
- E. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC): HVAC filters.
- F. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC): Testing HVAC systems for proper air flow rates, adjustment of dampers and registers, and settings for equipment.
- G. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC): Cleaning air ducts, equipment, and terminal units.

1.04 REFERENCE STANDARDS

- A. ASHRAE Std 52.2 - Method of Testing General Ventilation Air-Cleaning Devices for Removal Efficiency by Particle Size; 2017, with Addendum (2022).

- B. ASHRAE Std 129 - Measuring Air-Change Effectiveness; 1997 (Reaffirmed 2002).
- C. ASTM D5197 - Standard Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology); 2021.
- D. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; 2019.
- E. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- F. EPA 600/4-90/010 - Compendium of Methods for the Determination of Air Pollutants in Indoor Air; 1990.
- G. EPA 625/R-96/010b - Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air; 1999, with Addendum (2000).
- H. SMACNA (OCC) - IAQ Guidelines for Occupied Buildings Under Construction; 2007.

1.05 DEFINITIONS

- A. Adsorptive Materials: Gypsum board, acoustical ceiling tile and panels, carpet and carpet tile, fabrics, fibrous insulation, and other similar products.
- B. Contaminants: Gases, vapors, regulated pollutants, airborne mold and mildew, and the like, as specified.
- C. Particulates: Dust, dirt, and other airborne solid matter.
- D. Wet Work: Concrete, plaster, coatings, and other products that emit water vapor or volatile organic compounds during installation, drying, or curing.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Indoor Air Quality Management Plan: Describe, in detail, measures to be taken to promote adequate indoor air quality upon completion; use SMACNA (OCC) as a guide.
 - 1. Submit not less than 60 days before enclosure of building.
 - 2. Identify potential sources of odor and dust.
 - 3. Identify construction activities likely to produce odor or dust.
 - 4. Identify areas of project potentially affected, especially occupied areas.
 - 5. Evaluate potential problems by severity and describe methods of control.
 - 6. Describe construction ventilation to be provided, including type and duration of ventilation, use of permanent HVAC systems, types of filters and schedule for replacement of filters.
 - 7. Describe cleaning and dust control procedures.
 - 8. Describe coordination with commissioning procedures.
- C. Interior Finishes Installation Schedule: Identify each interior finish that either generates odors, moisture, or vapors or is susceptible to adsorption of odors and vapors, and indicate air handling zone, sequence of application, and curing times.
- D. Duct and Terminal Unit Inspection Report.
- E. Air Contaminant Test Plan: Identify:
 - 1. Testing agency qualifications.
 - 2. Locations and scheduling of air sampling.
 - 3. Test procedures, in detail.

4. Test instruments and apparatus.
5. Sampling methods.
- F. Air Contaminant Test Reports: Show:
 1. Location where each sample was taken, and time.
 2. Test values for each air sample; average the values of each set of 3.
 3. HVAC operating conditions.
 4. Certification of test equipment calibration.
 5. Other conditions or discrepancies that might have influenced results.
- G. Ventilation Effectiveness Test Plan: Identify:
 1. Testing agency qualifications.
 2. Description of test spaces, including locations of air sampling.
 3. Test procedures, in detail; state whether tracer gas decay or step-up will be used.
 4. Test instruments and apparatus; identify tracer gas to be used.
 5. Sampling methods.
- H. Ventilation Effectiveness Test Reports: Show:
 1. Preliminary tests of instruments and apparatus and of test spaces.
 2. Calculations of ventilation effectiveness, variable "E".
 3. Location where each sample was taken, and time.
 4. Test values for each air sample.
 5. HVAC operating conditions.
 6. Other information specified in ASHRAE Std 129.
 7. Other conditions or discrepancies that might have influenced results.

1.07 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: Independent testing agency having minimum of 5 years experience in performing the types of testing specified.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Low VOC Materials: See Section 01 61 16.
- B. Low VOC Materials: See other sections for specific requirements for materials with low VOC content.
- C. Auxiliary Air Filters: MERV of 8, minimum, when tested in accordance with ASHRAE Std 52.2.

PART 3 EXECUTION

3.01 CONSTRUCTION PROCEDURES

- A. Prevent the absorption of moisture and humidity by adsorptive materials by:
 1. Sequencing the delivery of such materials so that they are not present in the building until wet work is completed and dry.

2. Delivery and storage of such materials in fully sealed moisture-impermeable packaging.
3. Provide sufficient ventilation for drying within reasonable time frame.
- B. Begin construction ventilation when building is substantially enclosed.
- C. If extremely dusty or dirty work must be conducted inside the building, shut down HVAC systems for the duration; remove dust and dirt completely before restarting systems.
- D. When working in a portion of an occupied building, prevent movement of air from construction area to occupied area.
- E. HVAC equipment and supply air ductwork may be used for ventilation during construction:
 1. Operate HVAC system on 100 percent outside air, with 1.5 air changes per hour, minimum.
 2. Ensure that air filters are correctly installed prior to starting use; replace filters when they lose efficiency.
 3. Do not use return air ductwork for ventilation unless absolutely necessary.
 4. Where return air ducts must be used for ventilation, install auxiliary filters at return inlets, sealed to ducts; use filters with at least the equivalent efficiency as those required at supply air side; inspect and replace filters when they lose efficiency.
- F. Do not store construction materials or waste in mechanical or electrical rooms.
- G. Prior to use of return air ductwork without intake filters clean up and remove dust and debris generated by construction activities.
 1. Inspect duct intakes, return air grilles, and terminal units for dust.
 2. Clean plenum spaces, including top sides of lay-in ceilings, outsides of ducts, tops of pipes and conduit.
 3. Clean tops of doors and frames.
 4. Clean mechanical and electrical rooms, including tops of pipes, ducts, and conduit, equipment, and supports.
 5. Clean return plenums of air handling units.
 6. Remove intake filters last, after cleaning is complete.
- H. Do not perform dusty or dirty work after starting use of return air ducts without intake filters.
- I. Use other relevant recommendations of SMACNA (OCC) for avoiding unnecessary contamination due to construction procedures.

3.02 BUILDING FLUSH-OUT

- A. Contractor's Option: Either full continuous flush-out OR satisfactory air contaminant testing is required, not both.
- B. Perform building flush-out before occupancy.
- C. Do not start flush-out until:
 1. All construction is complete.
 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
 4. Inspection of inside of return air ducts and terminal units confirms that cleaning is not necessary.
 5. New HVAC filtration media have been installed.

- D. Building Flush-Out: Operate all ventilation systems at normal flow rates with 100 percent outside air until a total air volume of 14,000 cubic feet per square foot of floor area has been supplied.
 - 1. Obtain District's concurrence that construction is complete enough before beginning flush-out.
 - 2. Maintain interior temperature of at least 60 degrees F and interior relative humidity no higher than 60 percent.
 - 3. If additional construction involving materials that produce particulates or any of the specified contaminants is conducted during flush-out, start flush-out over.
 - 4. If interior spaces must be occupied prior to completion of the flush-out, supply a minimum of 25 percent of the total air volume prior to occupancy, and:
 - a. Begin ventilation at least three hours prior to daily occupancy.
 - b. Continue ventilation during all occupied periods.
 - c. Provide minimum outside air volume of 0.30 cfm per square foot or design minimum outside air rate, whichever is greater.
- E. Install new HVAC filtration media after completion of flush-out and before occupancy or further testing.

3.03 AIR CONTAMINANT TESTING

- A. Contractor's Option: Either full continuous flush-out, or satisfactory air contaminant testing is required, not both.
- B. Perform air contaminant testing before starting construction, as base line for evaluation of post-construction testing.
- C. Perform air contaminant testing before occupancy.
- D. Do not start air contaminant testing until:
 - 1. All construction is complete, including interior finishes.
 - 2. HVAC systems have been tested, adjusted, and balanced for proper operation.
 - 3. Cleaning of inside of HVAC ductwork, specified elsewhere, has been completed.
 - 4. New HVAC filtration media have been installed.
- E. Indoor Air Samples: Collect from spaces representative of occupied areas:
 - 1. Collect samples while operable windows and exterior doors are closed, HVAC system is running normally as if occupied, with design minimum outdoor air, but with the building unoccupied.
 - 2. Collect samples from spaces in each contiguous floor area in each air handler zone, but not less than one sample per 25,000 square feet; take samples from areas having the least ventilation and those having the greatest presumed source strength.
 - 3. Collect samples from height from 36 inches to 72 inches above floor.
 - 4. Collect samples from same locations on 3 consecutive days during normal business hours; average the results of each set of 3 samples.
 - 5. Exception: Areas with normal very high outside air ventilation rates, such as laboratories, do not need to be tested.
 - 6. When retesting the same building areas, take samples from at least the same locations as in first test.

- F. Outdoor Air Samples: Collect samples at outside air intake of each air handler at the same time as indoor samples are taken.
- G. Analyze air samples and submit report.
- H. Volatile Organic Compounds Limits:
 - 1. Comply with CalGreen Building Standards Section 5.504.4.5, Table 504.4.4.5 "Formaldehyde Limits".
 - 2. Formaldehyde: Not more than 16 parts per billion.
 - 3. Comply with CalGreen Building Standards Section 5.504, Table 504.4.3 "VOC Content Limits for Architectural Coatings".
 - 4. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit" and Table 504.4.2 "Sealant VOC Limit".
 - 5. Total Volatile Organic Compounds (TVOCs): Not more than 200 micrograms per cubic meter.
 - 6. Chemicals Listed in CAL (CDPH SM) Table 4-1, other than Formaldehyde: Not more than allowable concentrations listed in Table 4-1.
 - 7. Airborne Mold and Mildew: Measure in relation to outside air; not higher than outside air.
 - 8. Regulated Pollutants: Measure in relation to outside air; not more than contained in outside air.
- I. Air Contaminant Concentration Test Methods:
 - 1. Formaldehyde: ASTM D5197, EPA 625/R-96/010b Method TO-11A, or EPA 600/4-90/010 Method IP-6A.
 - 2. Particulates: EPA 600/4-90/010 Method IP-10.
 - 3. Total Volatile Organic Compounds (TVOC): EPA 625/R-96/010b Method TO-1, TO-15, or TO-17; or EPA 600/4-90/010 Method IP-1.
 - 4. Chemicals Listed in CAL (CDPH SM) Table 4-1, except Formaldehyde: ASTM D5197, or EPA 625/R-96/010b Method TO-1, TO-15, or TO-17.
 - 5. Carbon Monoxide: EPA 600/4-90/010 Method IP-3, plus measure outdoor air; measure in ppm; report both indoor and outdoor measurements.
- J. If air samples show concentrations higher than those specified, ventilate with 100 percent outside air and retest at no cost to District, or conduct full building flush-out specified above.

3.04 VENTILATION EFFECTIVENESS TESTING

- A. Perform ventilation effectiveness testing during commissioning period.
- B. Do not begin ventilation effectiveness testing until:
 - 1. HVAC testing, adjusting, and balancing has been satisfactorily completed.
 - 2. Building flush-out or air contaminant testing has been completed satisfactorily.
 - 3. New HVAC filtration media have been installed.
- C. Test each air handler zone in accordance with ASHRAE Std 129.
- D. If calculated air change effectiveness for a particular zone is less than 0.9 due to inadequate balancing of the system, adjust, and retest at no cost to District.

END OF SECTION

SECTION 01 58 13 TEMPORARY PROJECT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project identification sign.
- B. Project informational signs.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Responsibility to provide signs.
- B. Section 01 50 00 - Temporary Facilities and Controls: Temporary wood barriers and enclosures.
- C. Section 06 10 53 - Miscellaneous Rough Carpentry: General requirements for structural and non-structural rough carpentry Work.

1.03 REFERENCE STANDARDS

- A. FHWA (SHS) - Standard Highway Signs and Markings; 2004, with Supplement (2012).

1.04 QUALITY ASSURANCE

- A. Design sign and structure to withstand 80 miles/hr wind velocity.
- B. Sign Painter: Experienced as a professional sign painter for minimum three years.
 - 1. Sign painter shall be regularly engaged and specializing in the design, execution, construction and installation of exterior signage of equivalent type, size and complexity as those required for Project.
- C. Finishes, Painting: Adequate to withstand weathering, fading, and chipping for duration of construction.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawing: Show content, layout, lettering, color, foundation, structure, sizes and grades of members.

PART 2 PRODUCTS

2.01 SIGN MATERIALS

- A. Structure and Framing: New, wood, structurally adequate to support sign panel and suitable for specified finish.
- B. Sign Surfaces: Exterior grade plywood with medium or high density phenolic sheet overlay, minimum 3/4 inch thick, standard large sizes to minimize joints. Provide sheet thickness as required to span across framing members and provide even, smooth surface without waves or buckles.
- C. Rough Hardware: Galvanized steel, as specified in Section 05 50 00 - Metal Fabrications..

- D. Sign Face Paint and Primers: Exterior quality, primer, two gloss enamel finish coats; sign background of color as selected. Provide paint type as customarily used for sign painting, adequate to resist weathering and fading for the scheduled construction period.
- E. Sign Structure Paint and Primers: Exterior quality, primer, one gloss enamel finish coats; color as selected. Provide paint type as customarily used for sign painting, adequate to resist weathering and fading for the scheduled construction period.
- F. Lettering: Exterior quality paint, colors as selected.

2.02 PROJECT IDENTIFICATION SIGN

- A. One painted sign, 48 sq ft area, bottom 6 feet above ground.
- B. Content:
 - 1. Project number, title, logo and name of District as indicated on Contract Documents.
 - 2. Include organizational logos of parties identified on sign.
 - 3. Names and titles of authorities.
 - 4. Names and titles of Architect and Consultants.
 - 5. Name of Prime Contractor and major Subcontractors.
- C. Graphic Design, Colors, Style of Lettering: Designated by Architect.
 - 1. Sign Painting: Sign panels shall be shop painted and field installed.
 - a. Sign painting shall be performed by professional sign painters. Silk screen method is recommended in order to accurately depict graphics.
 - b. Paint back and edges of sign panels for complete weather resistance and finished appearance.
- D. Project Address Signs: Provide Project name and street address signs, minimum of 4 feet wide, to identify Project to facilitate deliveries.
 - 1. Graphic design and colors shall match Project Identification Sign.
 - 2. Text shall be as directed.
- E. Lettering: Standard Alphabet Series C, as specified in FHWA (SHS).

2.03 PROJECT INFORMATIONAL SIGNS

- A. Restrictions: Signs other than Project Identification Sign specified above and Project Informational Signs specified below shall not be displayed without approval of Architect.
- B. Project Informational Signs: Informational signs, necessary for conduct of construction activities or required by governmental authorities having jurisdiction may be displayed when in conformance to sign construction and graphic requirements specified in this Section.
 - 1. Architect may review such signs. If so, review will be for sign construction, and graphic designs only.
 - 2. Adequacy of signage for safety and conformance to requirements of authorities having jurisdiction and trade practices shall be solely Contractor's responsibility.
- C. Painted informational signs of same colors and lettering as Project Identification sign, or standard products; size lettering to provide legibility at 100 foot distance.
 - 1. Colors shall be as required by authorities having jurisdiction and, if not otherwise required, of colors consistent with Project graphics.
 - 2. Informational signage shall be produced by professional sign painters and be of size and lettering style consistent with use.

- D. Provide at each field office, storage shed , and directional signs to direct traffic into and within site. Relocate as Work progress requires.
- E. Provide municipal traffic agency directional traffic signs to and within site.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install project identification sign within 30 days after date fixed by Notice to Proceed.
- B. Erect at location of high public visibility adjacent to main entrance to site.
- C. Erect supports and framing on secure foundation, rigidly braced and framed to resist wind loadings.
- D. Install sign surface plumb and level, with butt joints. Anchor securely.
- E. Paint exposed surfaces and edges of sign, supports, and framing for a finished appearance.
- F. Project Identification Sign Installation
 - 1. Construction: Construct sign support structure and install panels in durable manner, to resist high winds.
 - 2. Installation: Erect Sign on site at a lighted location of high public visibility, adjacent to the main entrance to the site, as approved by Architect.
 - a. Install sign at height for optimum visibility, on ground-mounted poles or attached to portable structure on skids.
 - b. Portable structure shall resist overturning force of wind.
 - 3. Street Address Signs: Locate and install signs at each access point from public streets.
- G. Project Informational Signs Installation:
 - 1. Construction: Construct sign support structure and install panels in durable manner, to resist high winds.
 - 2. Project Informational Signs Installation:
 - a. Locate signs as necessary for construction activities and as required by authorities having jurisdiction.
 - b. Install informational signs for optimum visibility, on ground-mounted posts or temporarily attached to surfaces of structures.
 - c. Attachment methods shall leave no permanent disfiguration or discoloration on completed Work.

3.02 MAINTENANCE

- A. Maintain signs and supports neat clean condition. Repair all deterioration, weathering and damage to structure framing, and signage.
- B. Sign Relocation: Relocate signs as required by progress of the Work.

3.03 REMOVAL

- A. Remove signs, framing, supports, and foundations at completion of Project and restore the area prior to Final Inspection review.

END OF SECTION

SECTION 01 60 00 PRODUCT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. General product requirements.
 - 1. System Completeness.
 - 2. Installation of Products.
- B. Sustainable design-related product requirements.
- C. Re-use of existing products.
- D. Transportation, handling, storage and protection.
- E. Product option requirements.
- F. Substitution limitations.
- G. Procedures for District-supplied products.
- H. Maintenance materials, including extra materials, spare parts, tools, and software.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Identification of District-supplied products.
- B. Section 01 25 00 - Substitution Procedures: Substitutions made during procurement and/or construction phases.
- C. Section 01 40 00 - Quality Requirements: Product quality monitoring.
- D. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Requirements for VOC-restricted product categories.
- E. Section 01 74 19 - Construction Waste Management and Disposal: Waste disposal requirements potentially affecting product selection, packaging and substitutions.
- F. Technical Specifications Sections.

1.03 REFERENCE STANDARDS

- A. 16 CFR 260.13 - Guides for the Use of Environmental Marketing Claims; Federal Trade Commission; Recycled Content; Current Edition.
- B. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- C. GreenScreen (METH) - GreenScreen for Safer Chemicals Method v1.2; Clean Production Action; Current Edition.

1.04 SUBMITTALS

- A. Proposed Products List: Submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
 - 1. Submit within 30 calendar days after date of Agreement.
 - 2. For products specified only by reference standards, list applicable reference standards.

- B. Product Data Submittals: Submit manufacturer's standard published data. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.
- C. Shop Drawing Submittals: Prepared specifically for this Project; indicate utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.
- D. Sample Submittals: Illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.
 - 1. For selection from standard finishes, submit samples of the full range of the manufacturer's standard colors, textures, and patterns.

1.05 QUALITY ASSURANCE

- A. Build America and Buy America Act (BABA): Comply with 2 CFR Part 184, Buy America Preferences for Infrastructure Projects. See appendices A & B at the end of this section.
 - 1. This project has Federal Funding:
 - a. None of the funds made available for a Federal award for an infrastructure project may be obligated unless all of the iron, steel, manufactured products, and construction materials incorporated into the project are produced in the United States.
 - 2. Conform to Memorandum M-24-02 dated October 25, 2023, "Implementation Guidance on Application of Buy America Preference in Federal Financial Assistance Programs for Infrastructure."
 - a. "A Buy America preference only applies to articles, materials, and supplies that are consumed in, incorporated into, or affixed to an infrastructure project. As such, it does not apply to tools, equipment, and supplies, such as temporary scaffolding brought to the construction site and removed at or before the completion of the infrastructure project. Nor does a Buy America preference apply to equipment and furnishings, such as movable chairs, desks, and portable computer equipment, that are used at or within the finished infrastructure project, but are not an integral part of the structure or permanently affixed to the infrastructure project."
 - b. "Pursuant to Section 70914(b) of BABA and 2 CFR 184.7, the head of a Federal agency may waive the application of a Buy America preference under an infrastructure program in any case in which the head of the Federal agency finds that—
 - 1) Applying the Buy America preference would be inconsistent with the public interest (a "public interest waiver");
 - 2) Types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality (a "nonavailability waiver"); or
 - 3) The inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall project by more than 25 percent (an "unreasonable cost waiver")."
- B. CAL (CDPH SM) v1.1: California Department of Public Health (CDPH) Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers, v. 1.1–2010, for the emissions testing and requirements of products and materials.
 - 1. Best: GreenScreen Full Assessment by GreenScreen Licensed Profiler.

- C. Recycled Content: Determine percentage of post-consumer and pre-consumer (post-industrial) content separately, using the guidelines contained in 16 CFR 260.13.
 - 1. Previously used, reused, refurbished, and salvaged products are not considered recycled.
 - 2. Wood fabricated from timber abandoned in transit to original mill is considered reused, not recycled.
 - 3. Determine percentage of recycled content of any item by dividing the weight of recycled content in the item by the total weight of materials in the item.
 - 4. Determine value of recycled content of each item separately, by multiplying the content percentage by the value of the item.
 - 5. Acceptable Evidence:
 - a. For percentage of recycled content, information from manufacturer.
 - b. For cost, Contractor's cost data.

PART 2 PRODUCTS

2.01 GENERAL REQUIREMENTS

- A. Drawings and Specifications:
 - 1. If a conflict exists between the Drawings and the Specifications (Project Manual), then the Contractor is to submit a Request for Interpretation from the Architect.
 - a. As noted in the General Conditions, the more stringent requirements govern, including cost of materials and/or installation.
 - 2. If a specific product is indicated on the Drawings for use, then that product is to be used without exception in the location identified.
 - 3. If the Contractor proposes the use of another "or Equal" product other than the item indicated, whether or not listed in these specifications, Contractor must submit the product using the complete substitution process, **prior to bid**. See the the Article titled "SUBSTITUTIONS".
 - 4. DSA (Division of the State Architect) approval is also required prior to the use or installation of any substitution, on any product or location of product (requiring a revision to the Drawings or Specifications), included in these construction documents.
 - a. Installation of a non-approved product may result in the Contractor removing and replacing the non-approved product at the Contractor's own expense.
- B. General: Items purchased for incorporation in the Work, whether purchased for the Project or taken from previously purchased stock, and include materials, equipment, assemblies, fabrications and systems.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model designations indicated in the manufacturer's published product data.
 - 2. Materials: Products that are shaped, cut, worked, mixed, finished, refined or otherwise fabricated, processed or installed to form a part of the Work.
 - 3. Equipment: A product with operating parts, whether motorized or manually operated, that requires connections such as wiring or piping.
- C. Specific Product Requirements: Refer to requirements of Section 01 40 00 - Quality Requirements and individual product technical Sections for specific requirements for products.

- D. Minimum Requirements: Specified requirements for products are minimum requirements. Refer to general requirements for quality of the Work specified in Section 01 40 00 - Quality Requirements and elsewhere herein.
- E. Standard Products:
 - 1. Where specific products are not specified, provide standard products of types and kinds that are suitable for the intended purposes and that are usually and customarily used on similar projects under similar conditions.
 - 2. Products shall be as selected by Contractor and subject to review and acceptance by the District and Architect.
- F. Product Completeness:
 - 1. Provide products complete with all accessories, trim, finish, safety guards and other devices and details needed for a complete installation and for the intended use and effect.
 - 2. Comply with additional requirements specified herein in Article titled "SYSTEM COMPLETENESS".
- G. Code Compliance:
 - 1. All products, other than commodity products prescribed by Code, are to have a current ICC Evaluation Service Research Report (ICC ESR), CABO National Evaluation Report (NER), or other testing agencies as accepted by the Division of the State Architect.
 - 2. Refer to additional requirements specified in Section 01 41 00 - Regulatory Requirements.
- H. Mechanical and Plumbing: Comply with requirements specified in Divisions 22 and 23, as included in this Project Manual and in the Drawings.
- I. Electrical, Communications, and Electronic Safety and Security: Comply with requirements specified in Divisions 26, 27, and 28, as included in this Project Manual and in the Drawings.

2.02 SYSTEM COMPLETENESS

- A. The Contract Drawings and Specifications are not intended to be comprehensive directions on how to produce the Work. Rather, the Drawings and Specifications are instruments of service prepared to describe the design intent for the completed Work.
- B. It is intended that all equipment, systems and assemblies be complete and fully functional even though not fully described. Provide all products and operations necessary to achieve the design intent described in the Contract Documents.
- C. Refer to related general requirements specified in Section 01 41 00 - Regulatory Requirements regarding compliance with minimum requirements of applicable codes, ordinances and standards.
- D. Omissions and Misdescriptions: Contractor shall report to Architect immediately when elements essential to proper execution of the Work are discovered to be missing or misdescribed in the Drawings and Specifications or if the design intent is unclear.
 - 1. Should an essential element be discovered as missing or misdescribed prior to receipt of Bids, an Addendum will be issued so that all costs may be accounted for in the Contract Sum.
 - 2. Should an obvious omission or misdescription of a necessary element be discovered and reported after execution of the Agreement, Contractor shall provide the element as though fully and correctly described, and a no-cost Change Order shall be executed.
 - 3. Refer to related General Requirements specified in Section 01 30 00 - Administrative Requirements regarding construction interfacing and coordination.

2.03 EXISTING PRODUCTS

- A. Do not use materials and equipment removed from existing premises unless specifically required or permitted by Contract Documents.
- B. Unforeseen historic items encountered remain the property of the District; notify District promptly upon discovery; protect, remove, handle, and store as directed by District.
- C. Existing materials and equipment indicated to be removed, but not to be re-used, relocated, reinstalled, delivered to the District, or otherwise indicated as to remain the property of the District, become the property of the Contractor; remove from site.

2.04 NEW PRODUCTS

- A. Provide new products unless specifically required or permitted by Contract Documents.
 - 1. Provide products that fully comply with the Contract Documents, are undamaged and unused at installation.
 - 2. Comply with additional requirements specified herein in Article titled "PRODUCT OPTIONS".
- B. See Section 01 40 00 - Quality Requirements, for additional source quality control requirements.
- C. Use of products having any of the following characteristics is not permitted:
 - 1. Made outside the United States, its territories, Canada, or Mexico.
 - 2. Containing lead, cadmium, or asbestos.
- D. Where other criteria are met, Contractor shall give preference to products that:
 - 1. If used on interior, have lower emissions, as defined in Section 01 61 16.
 - 2. If wet-applied, have lower VOC content, as defined in Section 01 61 16.
 - 3. Are extracted, harvested, and/or manufactured closer to the location of the project.
 - 4. Have longer documented life span under normal use.
 - 5. Result in less construction waste. See Section 01 74 19
- E. Provide interchangeable components by the same manufacture for components being replaced.
 - 1. To the fullest extent possible, provide products of the same kind from a single source. Products required to be supplied in quantity shall be the same product and interchangeable throughout the Work.
 - 2. When options are specified for the selection of any of two or more products, provide product selected to be compatible with products previously selected.
- F. Product Nameplates and Instructions:
 - 1. Except for required Code-compliance labels and operating and safety instructions, locate nameplates on inconspicuous, accessible surfaces. Do not attach manufacturer's identifying nameplates or trademarks on surfaces exposed to view in occupied spaces or to the exterior.
 - 2. Provide a permanent nameplate on each item of service-connected or power-operated equipment. Nameplates shall contain identifying information and essential operating data such as the following example:
 - a. Name of manufacturer
 - b. Name of product
 - c. Model and serial number

- d. Capacity
- e. Operating and Power Characteristics
- f. Labels of Tested Compliance with Codes and Standards
- 3. Refer to additional requirements which may be specified in various sections, as included in this Project Manual.
- 4. For each item of service-connected or power-operated equipment, provide operating and safety instructions, permanently affixed and of durable construction, with legible machine lettering. Comply with all applicable requirements of authorities having jurisdiction and listing agencies.
- G. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Size terminal lugs to CEC/NFPA 70, include lugs for terminal box.
- H. Cord and Plug: Provide minimum 6 foot cord and plug including grounding connector for connection to electric wiring system. Cord of longer length is specified in individual specification sections.

2.05 PRODUCT OPTIONS

- A. Unless the specifications state that no substitution is permitted, whenever the Contract Documents indicate any specific article, device, equipment, product, material, fixture, patented process, form, method, or type of construction or any specific name, make, trade name, or catalog number, with or without the words "or equal," such specification shall be deemed to be used for the purpose of facilitating description of the material, process, or article desired and shall be deemed to be followed by the words "or equal."
 - 1. See Section 01 25 00 - Substitution Procedures.
- B. Products Specified by Reference Standards or by Description Only: Use any product meeting those standards or description.
 - 1. Reference Standards:
 - a. Where Specifications require compliance with a standard, provided product shall fully comply with the standard specified.
 - b. Refer to general requirements specified in Section 01 42 19 - Reference Standards regarding compliance with referenced standards, standard specifications, codes, practices and requirements for products.
 - 2. Product Description:
 - a. Where Specifications describe a product, listing characteristics required, with or without use of a brand name, provide a product that has the specified attributes and otherwise complies with specified requirements.
 - 3. Performance Requirements:
 - a. Where Specifications require compliance with performance requirements, provide product(s) that comply and are recommended by the manufacturer for the intended application.
 - b. Verification of manufacturer's recommendations may be by product literature or by certification of performance from manufacturer.
- C. Products Specified by Naming One or More Manufacturers with a Provision for Substitutions: Submit a request for substitution for any manufacturer not named, prior to bid .
- D. Products Specified by Identification of Manufacturer and Product Name or Number:
 - 1. "Specified Manufacturer": Provide the specified product(s) of the specified manufacturer.

- a. If only one manufacturer is specified, without "acceptable manufacturers" being identified, provide only the specified product(s) of the specified manufacturer.
 - b. If District standard is indicated make all efforts to provide that product.
 - c. If the phrase "or equal" or "approved equal" is stated or reference is made to the "or equal provision," products of other manufacturers may be provided if such products are equivalent to the specified product(s) of the specified manufacturer.
 - 1) Equivalence shall be demonstrated by submission of information in compliance with requirements of Section 01 25 00 - Substitution Procedures.
2. "Acceptable Manufacturers":
 - a. Product(s) of the named manufacturers, if equivalent to the specified product(s) of the specified manufacturer, will be acceptable in accordance with the requirements of Section 01 25 00 - Substitution Procedures.
 - 1) Exception: Considerations regarding changes in Contract Time and Contract Sum will be waived if no increase in Contract Time or Contract Sum results from use of such equivalent products.
3. Unnamed manufacturers: Product(s) of unnamed manufacturers will be acceptable **when disclosed during the bidding period** and only as follows:
 - a. Unless specifically stated that substitutions will not be accepted or considered, the phrase "or equal" shall be assumed to be included in the description of specified product(s).
 - b. Equivalent products of unnamed manufacturers will be accepted in accordance with the "or equal" provision specified herein, below.
 - c. If provided, prior to bid, products of unnamed manufacturers shall be subject to the requirements of Section 01 25 00 - Substitution Procedures.
4. Quality basis:
 - a. Specified product(s) of the specified manufacturer shall serve as the basis by which products by named acceptable manufacturers and products of unnamed manufacturers will be evaluated.
 - b. Where characteristics of the specified product are described, where performance characteristics are identified or where reference is made to industry standards, such characteristics are specified to identify the most significant attributes of the specified product(s) which will be used to evaluate products of other manufacturers.
- E. Products Specified by Combination of Methods: Where products are specified by a combination of attributes, including manufacturer's name, product brand name, product catalog or identification number, industry reference standard, or description of product characteristics, provide products conforming to all specified attributes.
- F. "Or Equal" Provision: Where the phrase "or equal" or the phrase "or approved equal" is included, equivalent product(s) of unnamed manufacturer(s) may be provided as specified above in subparagraph titled "Unnamed manufacturers" and Section 01 25 00 - Substitution Procedures with the following conditions:
 1. The requirements of Section 01 25 00 - Substitution Procedures applies to products provided under the "or equal" provision.
 - a. Exception: If the proposed product(s) are determined to be equivalent to the specified product(s) of the specified manufacturer, the requirement specified for substitutions to result in a net reduction in Contract Time or Contract Sum may be waived.

2. Use of product(s) under the "or equal" provision shall not result in any delay in completion of the Work, including completion of portions of the Work for use by District or for work under separate contract by District.
3. Use of product(s) under the "or equal" provision shall not result in any costs to the District, including design fees and permit and plan check fees.
4. Use of product(s) under the "or equal" provision shall not require substantial change in the intent of the design, in the opinion of the Architect.
 - a. The intent of the design shall include functional performance and aesthetic qualities.
5. The determination of equivalence will be made by the Architect and District, and such determination shall be final.

G. Visual Matching:

1. Where Specifications require matching a sample, the decision by the Architect on whether a proposed product matches shall be final.
2. Where no product visually matches but the product complies with other requirements, comply with provisions for substitutions for selection of a matching product in another category.

H. Visual Selection of Products:

1. Where requirements include the phrase "as selected from manufacturer's standard colors, patterns and textures", or a similar phrase, selections of products will be made by indicated party or, if not indicated, by the Architect. The will select color, pattern and texture from the product line of submitted manufacturer, if all other specified provisions are met.
2. The Architect will select color, pattern and texture from the product line of submitted manufacturer, if all other specified provisions are met.

2.06 MAINTENANCE MATERIALS

- A. Furnish extra materials, spare parts, tools, and software of types and in quantities specified in individual specification sections.
- B. Deliver to Project site; obtain receipt prior to final payment.

PART 3 EXECUTION

3.01 SUBSTITUTION LIMITATIONS

- A. See Section 01 25 00 - Substitution Procedures.

3.02 OWNER-SUPPLIED PRODUCTS

- A. See Section 01 10 00 - Summary for identification of District-supplied products.
- B. District's Responsibilities:
 1. Arrange for and deliver District reviewed shop drawings, product data, and samples, to Contractor.
 2. Arrange and pay for product delivery to site.
 3. On delivery, inspect products jointly with Contractor.
 4. Submit claims for transportation damage and replace damaged, defective, or deficient items.
 5. Arrange for manufacturers' warranties, inspections, and service.

C. Contractor's Responsibilities:

1. Review District reviewed shop drawings, product data, and samples.
2. Receive and unload products at site; inspect for completeness or damage jointly with District.
3. Handle, store, install and finish products.
4. Repair or replace items damaged after receipt.

3.03 TRANSPORTATION AND HANDLING

- A. Package products for shipment in manner to prevent damage; for equipment, package to avoid loss of factory calibration.
- B. If special precautions are required, attach instructions prominently and legibly on outside of packaging.
- C. Coordinate schedule of product delivery to designated prepared areas in order to minimize site storage time and potential damage to stored materials.
 1. Schedule delivery to minimize long-term storage and prevent overcrowding construction spaces.
 2. Coordinate with installation to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft and other losses.
- D. Transport and handle products in accordance with manufacturer's instructions.
- E. Transport products by methods to avoid product damage.
- F. Transport materials in covered trucks to prevent contamination of product and littering of surrounding areas.
- G. Promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.
- H. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage, and to minimize handling.
- I. Arrange for the return of packing materials, such as wood pallets, where economically feasible.

3.04 STORAGE AND PROTECTION

- A. Provide protection of stored materials and products against theft, casualty, or deterioration.
- B. Designate receiving/storage areas for incoming products so that they are delivered according to installation schedule and placed convenient to work area in order to minimize waste due to excessive materials handling and misapplication. See Section 01 74 19.
 1. Structural Loading Limitations: Handle and store products and materials so as not to exceed static and dynamic load-bearing capacities of project floor and roof areas.
- C. Inspection Provisions: Arrange storage to provide access for inspection and measurement of quantity or counting of units.
- D. Structural Considerations: Store heavy materials away from the structure in a manner that will not endanger supporting construction.
- E. Store and protect products in accordance with manufacturers' instructions.
- F. Store with seals and labels intact and legible.
- G. Arrange storage of materials and products to allow for visual inspection for the purpose of determination of quantities, amounts, and unit counts.

- H. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- I. For exterior storage of fabricated products, place on sloped supports above ground.
 - 1. Place products on raised blocks, pallets or other supports, above ground and in a manner to not create ponding or misdirection of runoff.
- J. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.
 - 1. Execute a formal supplemental agreement between District and Contractor allowing off-site storage, for each occurrence.
- K. Protect products from damage or deterioration due to construction operations, weather, precipitation, humidity, temperature, sunlight and ultraviolet light, dirt, dust, and other contaminants.
 - 1. Periodically inspect to ensure products are undamaged, and are maintained under required conditions.
 - 2. Remove and replace products damaged by improper storage or protection with new products at no change in Contract Sum or Contract Time.
 - 3. Weather-Resistant Storage:
 - a. Store moisture-sensitive products above ground, under cover in a weathertight enclosure or covered with an impervious sheet covering. Provide adequate ventilation to avoid condensation.
 - b. Maintain storage within temperature and humidity ranges required by manufacturer's instructions.
 - c. Store loose granular materials on solid surfaces in a well-drained area. Prevent mixing with foreign matter.
- L. Comply with manufacturer's warranty conditions, if any.
- M. Do not store products directly on the ground.
- N. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- O. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- P. Prevent contact with material that may cause corrosion, discoloration, or staining.
- Q. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- R. Arrange storage of products to permit access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

3.05 INSTALLATION OF PRODUCTS

- A. Comply with manufacturer's instructions and recommendations for installation of products, except where more stringent requirements are specified, are necessary due to Project conditions or are required by authorities having jurisdiction.
- B. Anchor each product securely in place, accurately located and aligned with other Work.
- C. Clean exposed surfaces and provide protection to ensure freedom from damage and deterioration at time of Completion review. Refer to additional requirements specified in General Conditions along with Section 01 50 00 - Temporary Facilities and Controls and Section 01 70 00 - Execution and Closeout Requirements.

3.06 PROTECTION OF COMPLETED WORK

- A. Provide barriers, substantial coverings and notices to protect installed Work from traffic and subsequent construction operations.
- B. Remove protective measures when no longer required and prior to Completion review of the Work.
- C. Comply with additional requirements specified in Section 01 50 00 - Temporary Construction Facilities and Controls.

END OF SECTION

SECTION 01 61 16 VOLATILE ORGANIC COMPOUND (VOC) CONTENT RESTRICTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Requirements for Indoor-Emissions-Restricted products.
- B. Requirements for VOC-Content-Restricted products.
- C. Requirement for installer certification that they did not use any non-compliant products.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures.
- B. Section 01 40 00 - Quality Requirements: Procedures for testing and certifications.
- C. Section 01 60 00 - Product Requirements: Fundamental product requirements, substitutions and product options, delivery, storage, and handling.
- D. Section 07 92 00 - Joint Sealants: Emissions-compliant sealants.

1.03 DEFINITIONS

- A. Indoor-Emissions-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Interior paints and coatings applied on site.
 - 2. Interior adhesives and sealants applied on site, including flooring adhesives.
 - 3. Flooring.
 - 4. Composite wood.
 - 5. Products making up wall and ceiling assemblies.
 - 6. Thermal and acoustical insulation.
 - 7. Other products when specifically stated in the specifications.
- B. VOC-Content-Restricted Products: All products in the following product categories, whether specified or not:
 - 1. Exterior and interior paints and coatings.
 - 2. Exterior and interior adhesives and sealants, including flooring adhesives.
 - 3. Wet-applied roofing and waterproofing.
 - 4. Other products when specifically stated in the specifications.
- C. Interior of Building: Anywhere inside the exterior weather barrier.
- D. Adhesives: All gunnable, trowelable, liquid-applied, and aerosol adhesives, whether specified or not; including flooring adhesives, resilient base adhesives, and pipe jointing adhesives.
- E. Sealants: All gunnable, trowelable, and liquid-applied joint sealants and sealant primers, whether specified or not; including firestopping sealants and duct joint sealers.
- F. Inherently Non-Emitting Materials: Products composed wholly of minerals or metals, unless they include organic-based surface coatings, binders, or sealants; and specifically the following:
 - 1. Concrete.
 - 2. Clay brick.

3. Metals that are plated, anodized, or powder-coated.
4. Glass.
5. Ceramics.
6. Solid wood flooring that is unfinished and untreated.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- C. CAL (CDPH SM) - Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers Version 1.2; 2017.
- D. CARB (ATCM) - Airborne Toxic Control Measure to Reduce Formaldehyde Emissions from Composite Wood Products; Current Edition.
- E. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- F. CHPS (HPPD) - High Performance Products Database; Current Edition.
- G. CRI (GL) - Green Label Testing Program - Certified Products; Current Edition.
- H. CRI (GLP) - Green Label Plus Testing Program - Certified Products; Current Edition.
- I. GreenSeal GS-36 - Standard for Adhesives for Commercial Use; 2013.
- J. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- K. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- L. SCS (CPD) - SCS Certified Products; Current Edition.
- M. UL (GGG) - GREENGUARD Gold Certified Products; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: For each VOC-restricted product used in the project, submit evidence of compliance.
- C. Installer Certifications Regarding Prohibited Content: Require each installer of any type of product (not just the products for which VOC restrictions are specified) to certify that either 1) no adhesives, joint sealants, paints, coatings, or composite wood or agrifiber products have been used in the installation of installer's products, or 2) that such products used comply with these requirements.
 1. Use the form following this section for installer certifications.
- D. Verification of compliance with VOC limits as specified in the CalGreen Code Section 5.504 shall be provided at the request of the Building Inspector.
 1. Product certification and specifications.
 2. Chain of custody certifications.
 3. Product, labeled and invoiced as meeting the Composite Wood Products regulation.
 4. Exterior grade products marked as meeting the PS-1 or PS-2 standards of the Engineered Wood Association, the Australian AS/NZS 2269 or European 636 3S standards
 5. Other methods approved by the building official.
- E.

1.06 QUALITY ASSURANCE

- A. Indoor Emissions Standard and Test Method: CAL (CDPH SM), using Standard Private Office exposure scenario and the allowable concentrations specified in the method, and range of total VOC's after 14 days.
 - 1. Wet-Applied Products: State amount applied in mass per surface area.
 - 2. Paints and Coatings: Test tinted products, not just tinting bases.
 - 3. Evidence of Compliance: Acceptable types of evidence are the following;
 - a. Current UL (GGG) certification.
 - b. Current SCS (CPD) Floorscore certification.
 - c. Current SCS (CPD) Indoor Advantage Gold certification.
 - d. Current listing in CHPS (HPPD) as a low-emitting product.
 - e. Current CRI (GLP) certification.
 - f. Test report showing compliance and stating exposure scenario used.
 - 4. Product data submittal showing VOC content is NOT acceptable evidence.
 - 5. Manufacturer's certification without test report by independent agency is NOT acceptable evidence.
- B. VOC Content Test Method: 40 CFR 59, Subpart D (EPA Method 24), or ASTM D3960, unless otherwise indicated.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Report of laboratory testing performed in accordance with requirements.
 - b. Published product data showing compliance with requirements.
 - c. Certification by manufacturer that product complies with requirements.
- C. Composite Wood Emissions Standard: CARB (ATCM) for ultra-low emitting formaldehyde (ULEF) resins.
 - 1. Evidence of Compliance: Acceptable types of evidence are:
 - a. Current SCS "No Added Formaldehyde (NAF)" certification; www.scscertified.com.
 - b. Report of laboratory testing performed in accordance with requirements.
 - c. Published product data showing compliance with requirements.
 - d. Certification by manufacturer that product complies with requirements.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. All VOC restricted products shall be compliant with local jurisdiction, South Coast Air Quality Management District, and California Green Standards Code, Rules and Regulations in effect at the time of installation. Products specified in this project shall be used as a basis of design. Updated products that are compliant with the rules in force at the time of installation shall be submitted as substitutions when they become available.

1. If a product is found to be non-compliant with the VOC rules at the scheduled time of installation, notify the Architect a minimum of 90 days prior to installation. Contractor shall submit a suggested compliant product that is equal to the performance and cost of the specified product using the substitution procedure.

2.02 MATERIALS

- A. All Products: Comply with the most stringent of federal, State, and local requirements, or these specifications.
- B. Indoor-Emissions-Restricted Products: Comply with Indoor Emissions Standard and Test Method, except for:
 1. Composite Wood, Wood Fiber, and Wood Chip Products: Comply with Composite Wood Emissions Standard or contain no added formaldehyde resins.
 - a. Comply with CalGreen Building Standards Section 5.504.4.5, Table 504.4.4.5 "Formaldehyde Limits".
 2. Inherently Non-Emitting Materials.
- C. VOC-Content-Restricted Products: VOC content not greater than required by the following:
 1. Adhesives, Including Flooring Adhesives: SCAQMD 1168 Rule.
 2. Aerosol Adhesives: GreenSeal GS-36.
 3. Joint Sealants: SCAQMD 1168 Rule.
 4. Paints and Coatings: Each color; most stringent of the following:
 - a. 40 CFR 59, Subpart D.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - d. CalGreen Building Standards Section 5.504, Table 504.4.3 "VOC Content Limits for Architectural Coatings".
 - e. Clear Wood Finishes, Floor Coatings, Stains, Primers and Shellacs: Do not exceed the VOC content limits established in SCAQMD 1113 rule.
 5. Wet-Applied Roofing and Waterproofing: Comply with requirements for paints and coatings.
 6. Carpet, Carpet Tile, and Adhesive: Provide products having VOC content not greater than that required for CRI (GLP) certification.
 - a. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit".
 7. Carpet Cushion: Provide products having VOC content not greater than that required for CRI (GL) certification.
 - a. Comply with CalGreen Building Standards Section 5.504, Table 504.4.1 "Adhesive VOC Limit".
- D. Other Product Categories: Comply with limitations specified elsewhere.

PART 3 EXECUTION

3.01 FIELD QUALITY CONTROL

- A. District reserves the right to reject non-compliant products, whether installed or not, and require their removal and replacement with compliant products at no extra cost to District.

- B. Additional costs to restore indoor air quality due to installation of non-compliant products will be borne by Contractor.

END OF SECTION

SECTION 01 61 16.01
ACCESSORY MATERIAL VOC CONTENT CERTIFICATION FORM

FORM

1.01 IDENTIFICATION:

- A. Project Name: Battles ES - TK-K Building and Site Upgrades
- B. Project No.: 75-24119-000
- C. Architect: DLR Group

1.02 USE OF THIS FORM:

- A. Because installers are allowed and directed to choose accessory materials suitable for the applicable installation, there is a possibility that such accessory materials might contain VOC content in excess of that permitted, especially where such materials have not been explicitly specified.
 - 1. Each installer of work on this project is required to certify that his/their use of these particular materials complies with the contract documents and to provide documentation showing that the products used do not contain the prohibited content.
- B. Contractor is required to obtain and submit this form from each installer of work on this project.
- C. For each product category listed, check the correct paragraph.
- D. If any of these accessory materials has been used, attach to this form product data and MSDS sheet for each such product.

1.03 VOC CONTENT RESTRICTIONS ARE SPECIFIED IN SECTION 01 61 16.

- A. Volatile organic compounds (VOCs) are defined by the U.S. EPA, California Air Resources Board (CARB), South Coast Air Quality Management District (SCAQMD), along with other state and local regulations applicable to this project.

2.01 PRODUCT CERTIFICATION

- A. I certify that the installation work of my firm on this project:
 - 1. [HAS] [HAS NOT] required the use of any ADHESIVES.
 - 2. [HAS] [HAS NOT] required the use of any JOINT SEALANTS.
 - 3. [HAS] [HAS NOT] required the use of any PAINTS OR COATINGS.
 - 4. [HAS] [HAS NOT] required the use of any COMPOSITE WOOD or AGRIFIBER PRODUCTS.
- B. Product data and MSDS sheets are attached.

3.01 CERTIFIED BY: (INSTALLER/MANUFACTURER/SUPPLIER FIRM)

- A. Firm Name: _____
- B. Print Name: _____

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

- C. Signature: _____
D. Title: _____ (officer of company)
E. Date: _____

END OF SECTION

SECTION 01 70 00 EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Examination, preparation, and general installation procedures.
- B. Requirements for alterations work, including selective demolition, except removal, disposal, and/or remediation of hazardous materials and toxic substances.
- C. Pre-installation meetings.
- D. Cutting and patching.
- E. Surveying for laying out the work.
- F. Cleaning and protection.
- G. Starting of systems and equipment.
- H. Demonstration and instruction of District personnel.
- I. Closeout procedures, including Contractor's Correction Punch List, except payment procedures.
- J. General requirements for maintenance service.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: Limitations on working in existing building; continued occupancy; work sequence; identification of salvaged and relocated materials.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures.
- C. Section 01 31 14 - Facility Services Coordination: Coordination of trades.
- D. Section 01 40 00 - Quality Requirements: Testing and inspection procedures.
- E. Section 01 45 33 - Code-Required Special Inspections: Construction oversight procedures by Division of the State Architect regarding the execution, approval, and closeout of this building project.
- F. Section 01 71 23 - Field Engineering: Additional requirements for field engineering and surveying work.
- G. Section 01 74 19 - Construction Waste Management and Disposal: Additional procedures for trash/waste removal, recycling, salvage, and reuse.
- H. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance data, warranties, and bonds.
- I. Section 01 79 00 - Demonstration and Training: Demonstration of products and systems to be commissioned and where indicated in specific specification sections
- J. Section 02 41 00 - Demolition: Demolition of whole structures and parts thereof; site utility demolition.
- K. Individual Product Specification Sections:
 - 1. Advance notification to other sections of openings required in work of those sections.
 - 2. Limitations on cutting structural members.

1.03 REFERENCE STANDARDS

- A. CBC Chapter 11B - California Building Code-Chapter 11B.
- B. CFC Chapter 33 - California Fire Code - Chapter 33 - Fire Safety during Construction and Demolition.
- C. CFC Chapter 35 - California Fire Code - Chapter 35 - Welding and other Hot Work.
- D. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Survey work: Submit name, address, and telephone number of Surveyor before starting survey work.
 - 1. On request, submit documentation verifying accuracy of survey work.
 - 2. Submit a copy of site drawing signed by the Land Surveyor, that the elevations and locations of the work are in compliance with Contract Documents.
 - 3. Submit surveys and survey logs for the project record.
- C. Cutting and Patching: Submit written request in advance of cutting or alteration that affects:
 - 1. Structural integrity of any element of Project.
 - 2. Integrity of weather exposed or moisture resistant element.
 - 3. Efficiency, maintenance, or safety of any operational element.
 - 4. Visual qualities of sight exposed elements.
 - 5. Work of District or separate Contractor.
 - 6. Include in request:
 - a. Identification of Project.
 - b. Location and description of affected work.
 - c. Necessity for cutting or alteration.
 - d. Description of proposed work and products to be used.
 - e. Effect on work of District or separate Contractor.
 - f. Effect on existing construction of District and, if applicable, work for Project being provided by District under separate contract.
 - g. Written permission of affected separate Contractor.
 - h. Date and time work will be executed.
 - 7. Include written evidence that those performing work under separate contract for District have been notified and acknowledge that cutting and patching work will be occurring. Include written permission for intended cutting and patching, included scheduled times.
- D. Project Record Documents: Accurately record actual locations of capped and active utilities.

1.05 QUALIFICATIONS

- A. For demolition work, employ a firm specializing in the type of work required.
 - 1. Minimum of 5 years of documented experience.

- B. For surveying work, employ a land surveyor registered in California and acceptable to Architect. Submit evidence of surveyor's Errors and Omissions insurance coverage in the form of an Insurance Certificate. Employ only individual(s) trained and experienced in collecting and recording accurate data relevant to ongoing construction activities,
- C. For field engineering, employ a professional engineer of the discipline required for specific service on Project, licensed in California. Employ only individual(s) trained and experienced in establishing and maintaining horizontal and vertical control points necessary for laying out construction work on project of similar size, scope and/or complexity.
- D. For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in California.

1.06 PROJECT CONDITIONS

- A. Ventilate enclosed areas to assist cure of materials, to dissipate humidity, and to prevent accumulation of dust, fumes, vapors, or gases.
- B. Erosion and Sediment Control: Plan and execute work by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas. Prevent erosion and sedimentation.
 - 1. Minimize amount of bare soil exposed at one time.
 - 2. Provide temporary measures such as berms, dikes, and drains, to prevent water flow.
 - 3. Construct fill and waste areas by selective placement to avoid erosive surface silts or clays.
 - 4. Periodically inspect earthwork to detect evidence of erosion and sedimentation; promptly apply corrective measures.
- C. Noise Control: Provide methods, means, and facilities to minimize noise produced by construction operations.
 - 1. At All Times: Excessively noisy tools and operations will not be tolerated inside the building at any time of day; excessively noisy includes jackhammers, pneumatic hammers, and air-operated nail guns.
 - 2. Outdoors: Limit conduct of especially noisy exterior work to the hours of 8 am to 5 pm.
- D. Pest and Rodent Control: Provide methods, means, and facilities to prevent pests and insects from damaging the work.
- E. Rodent Control: Provide methods, means, and facilities to prevent rodents from accessing or invading premises.

1.07 COORDINATION

- A. See Section 01 10 00 for occupancy-related requirements.
- B. Coordinate scheduling, submittals, and work of the various sections of the Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Notify affected utility companies and comply with their requirements.
- D. Verify that utility requirements and characteristics of new operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, such equipment.

- E. Coordinate space requirements, supports, and installation of mechanical and electrical work that are indicated diagrammatically on drawings. Follow routing indicated for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- F. In finished areas except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- G. Coordinate completion and clean-up of work of separate sections.
- H. After District occupancy of premises, coordinate access to site for correction of defective work and work not in accordance with Contract Documents, to minimize disruption of District's activities.

PART 2 PRODUCTS

2.01 PATCHING MATERIALS

- A. New Materials: As specified in product sections; match existing products and work for patching and extending work.
- B. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing work as a standard.
- C. Product Substitution: For any proposed change in materials, submit request for substitution described in Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that existing site conditions and substrate surfaces are acceptable for subsequent work. Start of work means acceptance of existing conditions.
- B. Verify that existing substrate is capable of structural support or attachment of new work being applied or attached.
- C. Examine and verify specific conditions described in individual specification sections.
- D. Take field measurements before confirming product orders or beginning fabrication, to minimize waste due to over-ordering or misfabrication.
- E. Verify that utility services are available, of the correct characteristics, and in the correct locations.
- F. Prior to Cutting: Examine existing conditions prior to commencing work, including elements subject to damage or movement during cutting and patching. After uncovering existing work, assess conditions affecting performance of work. Beginning of cutting or patching means acceptance of existing conditions.

3.02 PREPARATION

- A. Clean substrate surfaces prior to applying next material or substance.
- B. Seal cracks or openings of substrate prior to applying next material or substance.
- C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying any new material or substance in contact or bond.

3.03 PREINSTALLATION MEETINGS

- A. When required in individual specification sections, convene a preinstallation meeting at the site prior to commencing work of the section.
 - 1. Coordinate operations of the various trades to assure efficient and orderly installation of each part of Work.
 - 2. Coordinate Work operations of the various trades that depend on each other for proper installation, connection, and operation of Work, including but not limited to:
 - a. Schedule construction operations in sequence required where installation of one part of Work depends on installation of other components, before or after its own installation.
 - b. Coordinate installation of different components to assure maximum accessibility for required maintenance, service, and repair.
 - c. Provide provisions to accommodate items scheduled for later installation.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Architect four days in advance of meeting date.
- D. Prepare agenda and preside at meeting:
 - 1. Review conditions of examination, preparation and installation procedures.
 - 2. Review coordination with related work.
- E. Record minutes and distribute copies within two days after meeting to participants, with electronic copies to Architect, District, participants, and those affected by decisions made.

3.04 LAYING OUT THE WORK

- A. Verify locations of survey control points prior to starting work.
- B. Promptly notify Architect of any discrepancies discovered.
- C. Protect survey control points prior to starting site work; preserve permanent reference points during construction.
- D. Promptly report to Architect the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
- E. Replace dislocated survey control points based on original survey control. Make no changes without prior written notice to Architect.
- F. Utilize recognized engineering survey practices.
- G. Establish a minimum of two permanent bench marks on site, referenced to established control points. Record locations, with horizontal and vertical data, on project record documents.
- H. Establish elevations, lines and levels. Locate and lay out by instrumentation and similar appropriate means:
 - 1. Site improvements including pavements; stakes for grading, fill and topsoil placement; utility locations, slopes, and invert elevations.
 - 2. Grid or axis for structures.
 - 3. Building foundation, column locations, ground floor elevations.
- I. Periodically verify layouts by same means.
- J. Maintain a complete and accurate log of control and survey work as it progresses.

3.05 GENERAL INSTALLATION REQUIREMENTS

- A. Dimensions for Accessibility:
 - 1. Conventions: See CBC Chapter 11B Figure 11B-104. Dimensions that are not stated as "maximum" or "minimum" are absolute.
 - 2. Tolerances shall be per CBC Chapter 11B-104.1.1 "Construction and manufacturing tolerances. All dimensions are subject to conventional industry tolerances except where the requirement is stated as a range with specific minimum and maximum end points."
- B. In addition to compliance with regulatory requirements, conduct construction operations in compliance with CFC Chapter 33, CFC Chapter 35, and NFPA 241, including applicable recommendations in Appendix A.
 - 1. When welding or doing other hot work, comply with CFC Chapter 35.
- C. Install products as specified in individual sections, in accordance with manufacturer's instructions and recommendations, and so as to avoid waste due to necessity for replacement.
- D. Make vertical elements plumb and horizontal elements level, unless otherwise indicated.
- E. Install equipment and fittings plumb and level, neatly aligned with adjacent vertical and horizontal lines, unless otherwise indicated.
- F. Make consistent texture on surfaces, with seamless transitions, unless otherwise indicated.
- G. Make neat transitions between different surfaces, maintaining texture and appearance.

3.06 ALTERATIONS

3.07 CUTTING AND PATCHING

- A. Whenever possible, execute the work by methods that avoid cutting or patching.
- B. See Alterations article above for additional requirements.
- C. Perform whatever cutting and patching is necessary to:
 - 1. Complete the work.
 - 2. Fit products together to integrate with other work.
 - 3. Provide openings for penetration of mechanical, electrical, and other services.
 - 4. Match work that has been cut to adjacent work.
 - 5. Repair areas adjacent to cuts to required condition.
 - 6. Repair new work damaged by subsequent work.
 - 7. Remove samples of installed work for testing when requested.
 - 8. Remove and replace defective and non-complying work.
- D. Execute work by methods that avoid damage to other work and that will provide appropriate surfaces to receive patching and finishing. In existing work, minimize damage and restore to original condition.
 - 1. Coordinate installation or application of products for integrated Work.
 - 2. Uncover completed Work as necessary to install or apply products out of sequence.
 - 3. Remove and replace defective or non-conforming Work.
 - 4. Provide openings for penetration of utility services, such as plumbing, mechanical and electrical Work.

- E. After uncovering existing Work, inspect conditions affecting proper accomplishment of Work.
- F. Temporary Supports: Provide supports to ensure structural integrity of the Work. Provide devices and methods to protect other portions of Project from damage.
- G. Beginning of cutting or patching shall be interpreted to mean that existing conditions were found by Contractor to be acceptable.
- H. Employ skilled and experienced installer to perform cutting for weather exposed and moisture resistant elements, and sight exposed surfaces.
- I. Cut rigid materials using masonry saw or core drill. Pneumatic tools not allowed without prior approval.
 - 1. Use a diamond grit abrasive saw or similar cutter for smooth edges. Do not overcut corners.
- J. Restore work with new products in accordance with requirements of Contract Documents.
- K. Fit work air tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- L. Fit work neat and tight allowing for expansion and contraction.
- M. At penetrations of fire rated walls, partitions, ceiling, or floor construction, completely seal voids with fire rated material , to full thickness of the penetrated element.
- N. Patching:
 - 1. Finish patched surfaces to match finish that existed prior to patching. On continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.
 - 2. Match color, texture, and appearance.
 - 3. Repair patched surfaces that are damaged, lifted, discolored, or showing other imperfections due to patching work. If defects are due to condition of substrate, repair substrate prior to repairing finish.
- O. Finishing: Refinish surfaces to match adjacent and similar finishes as used for the Project.
 - 1. For continuous surfaces, refinish to nearest intersection or natural break.
 - 2. For an assembly, refinish entire unit.

3.08 PROGRESS CLEANING

- A. Maintain areas free of waste materials, debris, and rubbish. Maintain site in a clean and orderly condition.
- B. Remove debris and rubbish from pipe chases, plenums, attics, crawl spaces, and other closed or remote spaces, prior to enclosing the space.
- C. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
- D. Collect and remove waste materials, debris, and trash/rubbish from site weekly and dispose off-site; do not burn or bury.

3.09 PROTECTION OF INSTALLED WORK

- A. Protect installed work from damage by construction operations.
- B. Provide special protection where specified in individual specification sections.
- C. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

- D. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- E. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- F. Protect work from spilled liquids. If work is exposed to spilled liquids, immediately remove protective coverings, dry out work, and replace protective coverings.
- G. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- H. Prohibit traffic from landscaped areas.
- I. Remove protective coverings when no longer needed; reuse or recycle coverings if possible.

3.10 SYSTEM STARTUP

- A. Coordinate schedule for start-up of various equipment and systems.
- B. Verify that each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions that may cause damage.
- C. Verify tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.
- D. Verify that wiring and support components for equipment are complete and tested.
- E. Execute start-up under supervision of applicable Contractor personnel and manufacturer's representative in accordance with manufacturers' instructions.
- F. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.
- G. Submit a written report that equipment or system has been properly installed and is functioning correctly.

3.11 COMMISSIONING PROJECT

- A. Project Completion
 - 1. Prior to notifying the Architect that the project is complete according to the construction and contract documents, submit to the Architect:
 - a. Approved pre-functional checklists and functional performance testing reports from the commissioning documentation.
- B. Final Acceptance
 - 1. Prior to requesting inspection for verification of completion of all outstanding items, submit to the Architect:
 - a. The commissioning requirements of Section 01 91 13 - General Commissioning Requirements must be complete prior to final acceptance, unless approved in writing by the District. Exceptions to this are any required seasonal or approved deferred testing.

3.12 DEMONSTRATION AND INSTRUCTION

- A. See Section 01 79 00 - Demonstration and Training.

3.13 ADJUSTING

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

3.14 FINAL CLEANING

- A. Execute final cleaning prior to final project assessment.
 - 1. Clean areas to be occupied by District prior to final completion before District occupancy.
- B. Use cleaning materials that are nonhazardous.
 - 1. Cleaning Agents and Materials: Use only those cleaning agents and materials which will not create hazards to health or property and which will not damage or degrade surfaces.
 - a. Use only those cleaning agents, materials and methods recommended by manufacturer of the material to be cleaned.
 - b. Use cleaning materials only on surfaces recommended by cleaning agent manufacturer.
 - c. Before use, review cleaning agents and materials with Construction Manager for suitability and compatibility. Use no cleaning agents and materials without approval as noted above.
 - 2. Cleaning Procedures: All cleaning processes, agents and materials shall be subject to Architect, District and/or Construction Manager review and approval. Processes and degree of cleanliness shall be as directed by Architect, District and/or Construction Manager.
- C. Clean interior and exterior glass, surfaces exposed to view; remove temporary labels, stains and foreign substances, polish transparent and glossy surfaces, vacuum carpeted and soft surfaces.
- D. Remove all labels that are not permanent. Do not paint or otherwise cover fire test labels or nameplates on mechanical and electrical equipment.
- E. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.
- F. Clean filters of operating equipment.
- G. Clean debris from roofs, gutters, downspouts, scuppers, overflow drains, area drains, and drainage systems.
- H. Clean site; sweep paved areas, rake clean landscaped surfaces.
- I. Remove waste, surplus materials, trash/rubbish, and construction facilities from the site; dispose of in legal manner; do not burn or bury.

3.15 PROJECT CLOSEOUT CONFERENCE

- A. Schedule and conduct a project closeout conference, at a time convenient to District and Architect, but no later than 90 days prior to the scheduled date of Completion.
 - 1. Conduct the conference to review requirements and responsibilities related to Project closeout.
 - 2. Attendees: Authorized representatives of District, Commissioning Authority (CxA), Architect, and relevant consultants; Contractor and project superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.

3. Agenda: Discuss items of significance that could affect or delay Project closeout, including the following:
 - a. Preparation of record documents.
 - b. Procedures required prior to inspection for Completion and for final inspection for acceptance.
 - c. Submittal of written warranties.
 - d. Coordination of separate contracts.
 - e. Installation of District's furniture, fixtures, and equipment.
 - f. Responsibility for removing temporary facilities and controls.
4. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.

3.16 CLOSEOUT PROCEDURES

- A. Make submittals that are required by governing or other authorities.
 1. Provide copies to Architect and District.
- B. Accompany District, Architect, and Construction Manager on preliminary inspection to determine items to be listed for completion or correction in the Contractor's Correction Punch List for Contractor's comprehensive list of items to be completed or corrected.
 1. As authorized by the District; Architect and Architect's / District's consultants, as appropriate, will attend a meeting at the Project site to review Contract closeout procedures and to review the list of items to be completed and corrected (punch list) to make the Work ready for acceptance by the District.
 2. This meeting shall be scheduled not earlier than 14 days prior to the date anticipated for the Final Inspection review.
- C. Notify Architect when work is considered ready for Architect's Substantial Completion inspection.
- D. Submit written certification containing Contractor's Correction Punch List, that Contract Documents have been reviewed, work has been inspected, and that work is complete in accordance with Contract Documents and ready for Architect's Substantial Completion inspection.
 1. Final Application for Payment: In the Application for Payment that coincides with the date Final Inspection/Completion is claimed, show 100 percent completion for the portion of the Work claimed substantially complete.
 2. Warranties, Bonds and Certificates: Submit specific warranties, guarantees, workmanship bonds, maintenance agreements, final certifications and similar documents.
 3. Locks and Keys: Change temporary lock cylinders over to permanent keying and transmit keys to the District, unless otherwise directed or specified.
 4. Tests and Instructions: Complete start-up testing of systems, and instruction of the District's personnel. Remove temporary facilities from the site, along with construction tools, mock-ups, and similar elements.
- E. Clearing and Cleaning: Prior to the Final Inspection review, Contractor shall conduct a thorough cleaning and clearing of the Project area, including removal of construction facilities and temporary controls.

- F. Inspection and Testing: Prior to the Final Inspection review, complete inspection and testing required for the Work, including securing of approvals by authorities having jurisdiction.
- G. District will occupy all of the building as specified in Section 01 10 00.
- H. Conduct Final inspection and create Final Correction Punch List containing Architect's and Contractor's comprehensive list of items identified to be completed or corrected and submit to Architect.
 - 1. Correction (Punch) List: Contractor shall prepare and distribute at the preliminary Contract closeout review meeting, a typewritten, comprehensive list of items to be completed and corrected (punch list) to make the Work ready for acceptance by the District.
 - a. Include all items to be completed or corrected prior to the Contractor's application for final payment.
 - b. Identify items by location (room number or name) and consecutive number. For example, 307-5 would identify item 5 in Room 307, Roof-4 would identify item 4 on Roof.
 - c. Prepare separate lists according to categories used for Drawings. For example, provide lists for Architectural, Structural, Plumbing, Mechanical, Electrical, Fire Protection, Civil, and Landscape.
 - d. Architect, Architect's consultants and District's consultants, if in attendance, will conduct a brief walk-through of Project with the Contractor to review scope and adequacy of the punch list.
 - e. Verbal comments will be made to the Contractor by the DSA, the Architect and the Architect's and District's consultants, if in attendance, during the walk-through. These comments will indicate generally the additions and corrections to be made to the punch list. Such comments shall not be considered to be comprehensive; Contractor shall use the comments as guidance in preparing the punch list for the Final Inspection review.
 - 2. Final Inspection Meeting: On a date mutually agreed by the District, Architect, and Contractor, a meeting shall be conducted at the Project site to determine whether the Work is satisfactory and complete for filing a Notice of Completion.
 - a. Contractor shall provide three working days notice to Architect for requested date of Final Inspection meeting.
 - b. The Construction Manager, the Architect with Architect's / District's consultants, as authorized by the District, will attend the Final Inspection meeting.
 - c. In addition to conducting a walk-through of the facility and reviewing the punch list, the purpose of the meeting shall include submission of warranties, guarantees and bonds to the District, submission of operation and maintenance data (manuals), provision of specified extra materials to the District, and submission of other Contract closeout documents and materials as required and if not already submitted.
 - d. The Construction Manager, Architect and Architect's consultants, as appropriate, will conduct a walk-through of the facility with the Contractor and review the punch list.
 - e. Contractor shall correct the punch list and record additional items as may identified during the walk-through, including notations of corrective actions to be taken.
 - f. Retype the punch list and distribute it within three working days to those attending the meeting.

- g. If additional site visits by the Construction Manager, the Architect and the Architect's and District's consultants are required to review completion and correction of the Work, the costs of additional visits shall be reimbursed to the District by the Contractor by deducting such costs from the Final Payment.
- I. Correct items of work listed in Final Correction Punch List and comply with requirements for access to District-occupied areas.
- J. Notify Architect when work is considered finally complete and ready for Architect's Final Inspection.
 - 1. Architect's Certification of Completion:
 - a. When Architect determines that list of items to be completed and corrected (Punch List) is sufficiently complete for District to occupy Project for the use to which it is intended.
- K. Complete items of work determined by Architect listed in executed Certificate of Substantial Completion.

3.17 FINAL PAYMENT

- A. After completion of all items listed for completion and correction, after submission of all documents and products and after final cleaning, submit final Application for Payment, identifying total adjusted Contract Sum, previous payments and sum remaining due.
- B. Payment will not be made until the following are accomplished:
 - 1. All Project Record Documents have been transferred and accepted by District.
 - 2. All extra materials and maintenance stock have been transferred and received by District.
 - 3. All warranty documents and operation and maintenance data have been received and accepted by District.
 - 4. All liens have been released or bonded by Contractor.
 - 5. Contractor's surety has consented to Final Payment.
 - 6. All documentation required by DSA has been completed.

3.18 MAINTENANCE

- A. Provide service and maintenance of components indicated in specification sections.
- B. Maintenance Period: As indicated in specification sections or, if not indicated, not less than one year from the Date of Project Completion or the length of the specified warranty, whichever is longer.
- C. Examine system components at a frequency consistent with reliable operation. Clean, adjust, and lubricate as required.
- D. Include systematic examination, adjustment, and lubrication of components. Repair or replace parts whenever required. Use parts produced by the manufacturer of the original component.
- E. Maintenance service shall not be assigned or transferred to any agent or subcontractor without prior written consent of the District.

END OF SECTION

SECTION 01 71 23 FIELD ENGINEERING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field engineering services by Contractor.
- B. Construction surveying by Contractor.
- C. Support and bracing.

1.02 DESCRIPTION OF SERVICES

- A. Specific services listed in this section are in addition to, and do not supersede, general Execution and Closeout Requirements.
- B. Sole responsibility for establishing all locations, dimensions and levels of items of work.
- C. Sole responsibility for provision of all materials required to establish and maintain benchmarks and control points, including batter boards, grade stakes, structure, and pipeline elevation stakes, and other items.
- D. Having a skilled instrument person(s) available on short notice when necessary for laying out the work.
- E. Provision of facilities and assistance necessary for Architect to check lines and grade points placed by Contractor.
 - 1. Performance of excavation or embankment work until after all cross-sectioning necessary for determining payment quantities for Unit Price work have been completed and accepted by Architect.
- F. Preparation and maintenance of daily reports of activity on the work. Submission of reports containing key progress indicators and job conditions to Architect.
 - 1. Number of employees at the Site.
 - 2. Number employees at the Site for each of Contractor's subcontractors.
 - 3. Breakdown of employees by trades.
 - 4. Major equipment and materials installed as part of the work.
 - 5. Major construction equipment utilized.
 - 6. Location of areas in which construction was performed.
 - 7. Materials and equipment received.
 - 8. Work performed, including field quality control measures and testing.
 - 9. Weather conditions.
 - 10. Safety.
 - 11. Delays encountered, amount of delay incurred, and the reasons for the delay.
 - 12. Instructions received from Architect or District, if any.
- G. Preparation and maintenance of professional-quality, accurate, well organized, legible notes of all measurements and calculations made while surveying and laying out the work.
- H. Prior to backfilling operations, surveying - locating, and recording on a copy of Contract Documents - an accurate representation of buried work and Underground Facilities encountered.

- I. Setting up and executing time-lapse photography of construction activities.

1.03 REFERENCE STANDARDS

- A. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems; 2008.
- B. State Plane Coordinate System for California.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Submit in addition to items required in Section 01 70 00 - Execution and Closeout Requirements.
- C. Informational Submittals: Submit the following:
 - 1. Field Engineering: Submit daily reports, with content as indicated in this section.
 - a. When requested by Architect, submit for Record documentation verifying accuracy of field engineering including, but not limited to, Contractor's survey notes and field notes.
 - 2. Final property survey.

1.06 QUALITY ASSURANCE

- A. Field Engineer's Qualifications: As established in Section 01 70 00 - Execution and Closeout Requirements.
- B. Use adequate number of skilled and thoroughly-trained workers to perform the work of this section in a timely and comprehensive manner.
- C. Minimum accuracy for required work is as follows:
 - 1. Grade: Horizontal Tolerance: Plus or minus 0.5 feet, Vertical Tolerance: Plus or minus 0.05 feet.
 - 2. Culverts and ditches: Horizontal Tolerance: Plus or minus 0.5 feet, Vertical Tolerance: Plus or minus 0.05 feet.
 - 3. Structures: Horizontal Tolerance: Plus or minus 0.5 feet (location), Vertical Tolerance: Plus or minus 0.05 feet.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify layout information shown on drawings in relation to property survey and existing benchmarks.
- B. Notify District's representative and Architect of discrepancies immediately in writing before proceeding to lay out work.
- C. Locate and protect existing benchmarks, base lines, and demarcations. Preserve permanent reference points during construction.

- D. Existing Utilities and Equipment: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning sitework, investigate and verify existing conditions.

3.02 FIELD ENGINEERING

- A. Maintain field office files, drawings, specifications, and record documents.
- B. Coordinate field engineering services with Contractor's subcontractors, installers, and suppliers as appropriate.
- C. Prepare layout and coordination drawings for construction operations.
- D. Check and coordinate the work for conflicts and interferences, and immediately advise Architect and District of all discrepancies of which Contractor is aware.
- E. Cooperate as required with Architect and District in observing the work and performing field inspections.
- F. Review and coordinate work on a regular basis with shop drawings and Contractor's other submittals.
- G. In general, match existing adjacent grades and maintain existing flow lines.
- H. Check the location, line and grade of every major element as the work progresses. Notify the Architect when deviations from required lines or grades exceed allowable tolerances. Include in such notifications a thorough explanation of the problem, and a proposed plan and schedule for remedying the deviation. Do not proceed with remedial work without District's concurrence of the remediation plan.
- I. Check all formwork, reinforcing, inserts, structural steel, bolts, sleeves, piping, other materials and equipment for compliance with shop drawings and Contract Documents requirements.
- J. Check all bracing and shoring for structural integrity and compliance with designs prepared by the Contractor.

3.03 CONSTRUCTION SURVEYING

- A. General: Perform surveying as applicable to specific items necessary for proper execution of work.
 - 1. Alignment Staking: Provide alignment stakes at 50 foot intervals on tangent, and at 25 foot intervals on curves.
 - 2. Slope Staking: Provide slope staking at 50 foot intervals on tangent, and at 25 foot intervals on curves. Re-stake at every ten-foot difference in elevation.
 - 3. Structure: Stake out structures, including elevations, and check prior to and during construction.
 - 4. Pipelines: Stake out pipelines including elevations, and check prior to and during construction.
 - 5. Site Utilities: Stake out utility lines including elevations, and check prior to and during construction.
 - 6. Cross-sections: Provide original, intermediate, and final staking as required, for site work and other locations as necessary for quantity surveys.
 - 7. Easement Staking: Provide easement staking at 50 foot intervals on tangent, and at 25 foot intervals on curves. If required by project conditions, provide wooden laths with flagging at 100 foot intervals.

8. Record Staking: Provide permanent stake at each blind flange and each utility cap is provided for future connections. Use stakes for record staking of material(s) acceptable to Architect.
9. Structural Frame: Upon completion, certify location and plumbness.
- B. Surveying to Determine Quantities for Payment.
 1. For each application for progress payment, perform such surveys and computations necessary to determine quantities of work performed or placed. Perform surveys necessary for Architect to determine final quantities of work in place.
 2. Notify Architect at least 24 hours before performing survey services for determining quantities. Unless waived in writing by Architect, perform quantity surveys in presence of Architect.
- C. Record Log: Maintain a log of layout control work. Record any deviations from required lines and levels. Include beginning and ending dates and times of surveys, weather conditions, name and duty of each survey party member, and types of instruments and tapes used.
- D. Use by the Architect: The Architect may at any time use line and grade points and markers established by the Contractor. The Contractor's surveys are a part of the work and may be checked by the Architect at any time.
- E. Accuracy:
 1. Establish Contractor's temporary survey references points for Contractor's use to at least second-order accuracy (e.g., 1:10000). Set construction staking used as a guide for the work to at least third-order accuracy (e.g., 1:5000). Provide the absolute margin for error specified below on the basis established by such orders.
 - a. Horizontal Accuracy of Easement Staking: Plus/minus 0.1 foot.
 - b. Accuracy of Other Staking: Plus/minus 0.04 foot horizontally and plus/minus 0.02 foot vertically.
 - c. Include an error analysis sufficient to demonstrate required accuracy in survey calculations.
 2. District reserves the right to check the Contractor's survey, measurements, and calculations. The requirement for accuracy will not be waived, whether this right is exercised or not.

3.04 SUPPORT AND BRACING

- A. General requirements: Design all support and bracing systems, if required. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Design systems to not overstress the building structure.
- B. Seismic Bracing: Design where required by authorities having jurisdiction.
 1. Design and install all support systems to comply with the seismic requirements of the Construction Code of California.
 2. Design and install seismic bracing so as not to defeat the operation on any required vibration isolation or sound isolation devices.
 3. For seismic bracing guidelines for mechanical, electrical and plumbing systems, refer to SMACNA (SRM).

3.05 REPORTS

- A. Submit two copies of Contractor's daily reports electronically to Architect and Construction Manager by 9:00 AM the next working day after the day covered in the associated report. Daily report shall be signed by responsible member of Contractor's staff, such as project manager or superintendent, or foreman designated by Contractor as having authority to sign daily reports.

3.06 RECORDS

- A. Maintain at the Site a complete and accurate log of control and survey work as it progresses.
 - 1. Organize and record survey data in accordance with recognized professional surveying standards, Laws and Regulations, and prevailing standards of practice in California. Record Contractor's surveyor's original field notes, computations, and other surveying data in Contractor-furnished hard-bound field books. Contractor is solely responsible for completeness and accuracy of survey work, and completeness and accuracy of survey records, including field books. Survey records,(including field books) may be rejected by District due to failure to organize and maintain survey records in a manner that allows reasonable and independent verification of calculations, and/or allows identification of elevations, dimensions, and grades of the work.
 - 2. Illegible notes or data, and erasures on any page of field books, are unacceptable. Do not submit copied notes or data. Corrections by ruling or lining out errors will be unacceptable unless initialed by the surveyor. Violation of these requirements may require re-surveying the data questioned by Architect.
- B. Submit three copies of final property survey to District. Include on the survey a certification, signed by the surveyor, that principal metes, bounds, lines, and levels of the Project are accurately positioned as shown on the survey. Include the following information:
 - 1. Structure locations from property lines, and distances to adjacent buildings.
 - 2. Dimensions and locations of drives, walks, walls, underground utilities, appurtenances, and major site features.
 - 3. Location of easements.
 - 4. Final grading topographic survey.

3.07 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.

END OF SECTION

SECTION 01 74 19 CONSTRUCTION WASTE MANAGEMENT AND DISPOSAL

PART 1 GENERAL

1.01 WASTE MANAGEMENT REQUIREMENTS

- A. Comply with the requirements Section 5.408 of the California Green Building Standards Code.
 - 1. Recycle and/or salvage for reuse a minimum of 65 percent of the nonhazardous construction and demolition waste in accordance with Section 504.8.1.1, 5.408.1.2, or 5.408.1.3; or meet a local construction and demolition waste management ordinance, whichever is more stringent.
- B. District requires that this project generate the least amount of trash and waste possible.
- C. Employ processes that ensure the generation of as little waste as possible due to error, poor planning, breakage, mishandling, contamination, or other factors.
- D. Minimize trash/waste disposal in landfills; reuse, salvage, or recycle as much waste as economically feasible.
- E. Required Recycling, Salvage, and Reuse: The following may not be disposed of in landfills or by incineration:
 - 1. Aluminum and plastic beverage containers.
 - 2. Corrugated cardboard.
 - 3. Wood pallets.
 - 4. Clean dimensional wood.
 - 5. Land clearing debris, including brush, branches, logs, and stumps; see Section 31 10 00 - Site Clearing for use options.
 - a. Comply with California Green Code (CGC) 5.408.3; Excavated soil and land clearing debris: 100 percent of trees, stumps, rocks and associated vegetation and soils resulting primarily from land clearing shall be reused or recycled.
 - 1) Exception: Reuse, either on-or off-site, of vegetation or soil contaminated by disease or pest infestation.
 - 6. Concrete: May be crushed and used as riprap, aggregate, sub-base material, or fill.
 - 7. Bricks: May be used on project if whole, or crushed and used as landscape cover, sub-base material, or fill.
 - 8. Concrete masonry units: May be used on project if whole, or crushed and used as sub-base material or fill.
 - 9. Asphalt paving: May be recycled into paving for project.
 - 10. Metals, including packaging banding, metal studs, sheet metal, structural steel, piping, reinforcing bars, door frames, and other items made of steel, iron, galvanized steel, stainless steel, aluminum, copper, zinc, lead, brass, and bronze.
 - 11. Glass.
 - 12. Gypsum drywall and plaster.
 - 13. Carpet, carpet cushion, carpet tile, and carpet remnants, both new and removed: DuPont (<http://flooring.dupont.com>) and Interface (www.interfaceinc.com) conduct reclamation programs.

14. Roofing.
15. Paint.
16. Plastic sheeting.
17. Rigid foam insulation.
18. Windows, doors, and door hardware.
19. Plumbing fixtures.
20. Mechanical and electrical equipment.
21. Fluorescent lamps (light bulbs).
22. Acoustical ceiling tile and panels.
23. Materials which could be hazardous and subject to special disposal regulations include but are not limited to the following: CalGreen Section 5.408.2
 - a. Lead-Based Paint
 - b. Asbestos: Found in older pipe insulation, asphalt floor tiles, linoleum, insulation, etc.
 - c. Polychlorinated Biphenyls (PCBs):
 - 1) Found in electrical oil filled equipment manufactured prior to 1978 such as transformers, switches and fluorescent lamp ballasts.
 - 2) Also found in adhesive, sealant, caulk, glazing putty, roofing material, pesticide vehicle, ink, paper, fabric dye, gaskets, and hydraulic fluid.
 - d. HVAC Refrigerants: Containing Fluorinated and Chlorinated compounds.
 - e. Drinking Fountain Refrigerants: Containing Fluorinated and Chlorinated compounds.
 - f. Fluorescent Light Tubes: Contain mercury.
 - g. EXIT signs and Smoke Detectors: May contain unregulated, radioactive tritium. Required to be returned to manufacturer.
 - h. Contaminated Soils.
 - i. Pressure Treated Lumber.
- F. Contractor Reporting Responsibilities: Submit periodic Waste Disposal Reports; report landfill disposal, recycling, salvage, and reuse regardless of to whom the cost or savings accrues; use the same units of measure on required reports.
 1. Contractor's quantitative reports for construction waste materials as a condition of approval of progress payments.
- G. Contractor shall develop and follow a Waste Management Plan designed to implement these requirements. CalGreen Section 5.408.1.1.
- H. The following sources may be useful in developing the Waste Management Plan:
 1. California Recycling Department, at www.dgs.ca.gov/BSC/CALGreen.
 2. General information contacts regarding construction and demolition waste:
 - a. Directory of Wood-Framed Building Deconstruction and Reused Building Materials Companies: www.fpl.fs.fed.us/documnts/fplgtr/fpl_gtr150.pdf.
 - b. Additional resources to be developed by Contractor with assistance from District and **Contractor, as requested.**
 3. Recycling Haulers and Markets: The source list below contains local haulers and markets for recyclable materials. This list is provided for information only and is not necessarily comprehensive; other haulers and markets are acceptable.

- a. CAL-MAX: www.calrecycle.ca.gov.
 - 1) A free service designed to help businesses find markets for non-hazardous materials they have traditionally discarded.
- b. General Recycling/Reuse Centers: For information on qualified local solid waste haulers contact the California Department of Resources Recycling and Recovery - CalRecycle. The website lists wastes recycling facilities in counties throughout the State of California.
- 4. Recycling Economics Information: The above lists contain information that may be useful in estimating the costs or savings or recycling options.
- I. Methods of trash/waste disposal that are not acceptable are:
 - 1. Burning on the project site.
 - 2. Burying on the project site.
 - 3. Dumping or burying on other property, public or private.
 - 4. Other illegal dumping or burying.
 - 5. Incineration, either on- or off-site.
- J. Regulatory Requirements: Contractor is responsible for knowing and complying with regulatory requirements, including but not limited to Federal, state and local requirements, pertaining to legal disposal of all construction and demolition waste materials.

1.02 RELATED REQUIREMENTS

- A. Section 01 10 00 - Summary: List of items to be salvaged from the existing building for relocation in project or for District.
- B. Section 01 25 00 - Substitution Procedures.
- C. Section 01 30 00 - Administrative Requirements: Additional requirements for project meetings, reports, submittal procedures, and project documentation.
- D. Section 01 50 00 - Temporary Facilities and Controls: Additional requirements related to trash/waste collection and removal facilities and services.
- E. Section 01 60 00 - Product Requirements: Waste prevention requirements related to product substitutions.
- F. Section 01 60 00 - Product Requirements: Waste prevention requirements related to delivery, storage, and handling.
- G. Section 01 70 00 - Execution and Closeout Requirements: Trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.
- H. Section 31 10 00 - Site Clearing: Handling and disposal of land clearing debris.

1.03 DEFINITIONS

- A. Clean: Untreated and unpainted; not contaminated with oils, solvents, caulk, or the like.
- B. Construction and Demolition Waste: Solid wastes typically including building materials, packaging, trash, debris, and rubble resulting from construction, remodeling, repair and demolition operations.
 - 1. Debris that is not hazardous as defined in CalGreen Section 5.408.2 and California Code of Regulations, Title 22, Section 66261.3 et seq.
 - 2. This term includes, but is not limited to, asphalt concrete, Portland cement concrete, brick, lumber, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, plastic pipe, and steel.

3. The debris may be commingled with rock, soil, tree stumps, and other vegetative matter resulting from land clearing and landscaping for construction or land development projects.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Diversion: Avoidance of demolition and construction waste sent to landfill or incineration. Diversion does not include using materials for landfill, alternate daily cover on landfills, or materials used as fuel in waste-to-energy processes.
- E. Enforcement Agency (EA). Enforcement agency as defined in CA Public Resources Code 40130.
- F. Hazardous: Exhibiting the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity or reactivity.
- G. Landfill, Inert waste or Inert Disposal Facility:
 1. A disposal facility that accepts only inert waste such as soil and rock, fully cured asphalt paving, uncontaminated concrete (including fiberglass or steel reinforcing rods embedded in the concrete), brick, glass, and ceramics, for land disposal.
- H. Landfill, Class III:
 1. A landfill that accepts non-hazardous resources such as household, commercial, and industrial waste, resulting from construction, remodeling, repair, and demolition operations.
 2. A Class III landfill must have a solid waste facilities permit from the California Integrated Waste Management Board (CIWMB) and is regulated by the Enforcement Agency (EA).
- I. Mixed Debris: Loads that include commingled recyclable and non-recyclable materials generated at the construction site.
- J. Mixed Debris Recycling Facility: A processing facility that accepts loads of commingled construction and demolition debris for the purpose of recovering re-usable and recyclable materials and disposing the non-recyclable residual materials.
- K. Nonhazardous: Exhibiting none of the characteristics of hazardous substances, i.e., ignitibility, corrosivity, toxicity, or reactivity.
- L. Nontoxic: Neither immediately poisonous to humans nor poisonous after a long period of exposure.
- M. Recyclable: The ability of a product or material to be recovered at the end of its life cycle and remanufactured into a new product for reuse by others.
- N. Recycle: To remove a waste material from the project site to another site for remanufacture into a new product for reuse by others.
- O. Recycling: The process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for the purpose of using the altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- P. Recycling Center: A facility that receives only C&D material that has been separated for reuse prior to receipt, in which the residual (disposed) amount of waste in the material is less than 10% of the amount separated for reuse by weight.
- Q. Return: To give back reusable items or unused products to vendors for credit.
- R. Reuse: To reuse a construction waste material in some manner on the project site.
- S. Salvage: To remove a waste material from the project site to another site for resale or reuse by others.

- T. Sediment: Soil and other debris that has been eroded and transported by storm or well production run-off water.
- U. Separated for Reuse:
 - 1. Materials, including commingled recyclables.
 - 2. Separated or kept separate from the solid waste stream for the purpose of:
 - a. Additional sorting or processing those materials for reuse or recycling.
 - 1) In order to return them to the economic mainstream in the form of raw material for new, reused, or reconstituted products.
 - b. Products shall meet the quality standards necessary to be used in the marketplace.
 - c. Includes materials that have been "source separated".
- V. Solid Waste:
 - 1. All putrescible and nonputrescible solid, semisolid, and liquid wastes, including:
 - a. Garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes.
 - b. Abandoned vehicles and parts thereof.
 - c. Discarded home and industrial appliances.
 - d. Dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste.
 - e. Manure, vegetable or animal solid and semisolid wastes.
 - f. Other discarded solid and semisolid wastes.
 - 2. "Solid waste" does not include hazardous waste, radioactive waste, or medical waste as defined or regulated by State law.
- W. Source Separation: The act of keeping different types of waste materials separate beginning from the first time they become waste.
 - 1. Materials, including commingled recyclables, that have been separated or kept separate from the solid waste stream at the point of generation, for the purpose of additional sorting or processing of those materials for reuse or recycling in order to return them to the economic mainstream in the form of raw materials for new, reused, or reconstituted products which meet the quality standards necessary to be used in the marketplace.
- X. Toxic: Poisonous to humans either immediately or after a long period of exposure.
- Y. Trash: Any product or material unable to be reused, returned, recycled, or salvaged.
- Z. Waste: Extra material or material that has reached the end of its useful life in its intended use. Waste includes salvageable, returnable, recyclable, and reusable material.
- AA. Waste Hauler: A company that possesses a valid permit from the local waste management authority to collect and transport solid wastes from individuals or businesses for the purpose of recycling or disposal in the locality.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Submit Waste Management Plan within 30 calendar days after receipt of Notice to Proceed, or prior to any trash or waste removal, whichever occurs sooner; submit projection of all trash and waste that will require disposal and alternatives to landfilling.
 - 1. Submit four copies of CWMP for review.
 - a. Contractor's Construction Waste and Recycling Plan must be approved by the Architect and Construction Manager prior to the start of Work.

2. Approval of the Contractor's CWMP shall not relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
- C. Waste Disposal Reports: Submit at specified intervals, with details of quantities of trash and waste, means of disposal or reuse, and costs; show both totals to date and since last report.
 1. Submit updated Report with each Application for Progress Payment; failure to submit Report will delay payment.
 - a. Inert materials shall achieve a construction waste diversion rate of at least 95 percent.
 - 1) These materials include, but are not limited to, concrete, asphalt and rock.
 - 2) Earthwork is not included.
 - 3) Excavated soil shall not be included in any of the calculations used to ensure compliance with this specification section.
 - b. The overall diversion rate must be based on weight.
 - c. The diversion rate of individual materials can be measured in either weight or volume, but the rate shall be converted into the units selected for calculating the overall diversion rate.
 - 1) All individual material diversions must be converted to a consistent set of units when calculating the overall diversion rate for the all reports and submittals required for the Work.
 - d. Base conversion rate numbers on standard conversion rate data for construction projects provided by the California Integrated Waste Management Board (CIWMB). This data is available at the following internet location, www.calrecycle.ca.gov/LGCentral/Library/Guidance.
 2. Submit Report on a form acceptable to District.
 3. Landfill Disposal: Include the following information:
 - a. Identification of material.
 - b. Amount, in tons or cubic yards, of trash/waste material from the project disposed of in landfills.
 - c. State the identity of landfills, total amount of tipping fees paid to landfill, and total disposal cost.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 4. Recycled and Salvaged Materials: Include the following information for each:
 - a. Identification of material, including those retrieved by installer for use on other projects.
 - b. Amount, in tons or cubic yards, date removed from the project site, and receiving party.
 - c. Transportation cost, amount paid or received for the material, and the net total cost or savings of salvage or recycling each material.
 - d. Include manifests, weight tickets, receipts, and invoices as evidence of quantity and cost.
 - e. Certification by receiving party that materials will not be disposed of in landfills or by incineration.
 5. Material Reused on Project: Include the following information for each:

- a. Identification of material and how it was used in the project.
 - b. Amount, in tons or cubic yards.
 - c. Include weight tickets as evidence of quantity.
6. Other Disposal Methods: Include information similar to that described above, as appropriate to disposal method.

PART 2 PRODUCTS

2.01 PRODUCT SUBSTITUTIONS

- A. See Section 01 60 00 and Section 01 25 00.
- B. For each proposed product substitution, submit the following information in addition to requirements specified in Section 01 60 00:
 1. Relative amount of waste produced, compared to specified product.
 2. Cost savings on waste disposal, compared to specified product, to be deducted from the Contract Sum.
 3. Proposed disposal method for waste product.
 4. Markets for recycled waste product.

PART 3 EXECUTION

3.01 WASTE MANAGEMENT PROCEDURES

- A. See Section 01 30 00 for additional requirements for project meetings, reports, submittal procedures, and project documentation.
- B. See Section 01 50 00 for additional requirements related to trash/waste collection and removal facilities and services.
- C. See Section 01 60 00 for waste prevention requirements related to delivery, storage, and handling.
- D. See Section 01 70 00 for trash/waste prevention procedures related to demolition, cutting and patching, installation, protection, and cleaning.

3.02 WASTE MANAGEMENT PLAN IMPLEMENTATION

- A. Manager: Designate an on-site person or persons responsible for instructing workers and overseeing and documenting results of the Waste Management Plan.
- B. Communication: Distribute copies of the Waste Management Plan to job site foreman, each subcontractor, District, and Architect.
- C. Instruction: Provide on-site instruction of appropriate separation, handling, and recycling, salvage, reuse, and return methods to be used by all parties at the appropriate stages of the project.
- D. Meetings: Discuss trash/waste management goals and issues at project meetings.
 1. Prebid meeting.
 2. Preconstruction meeting.
 3. Regular job-site meetings.
- E. Facilities: Provide specific facilities for separation and storage of materials for recycling, salvage, reuse, return, and trash disposal, for use by all contractors and installers.

1. As a minimum, provide:
 - a. Separate area for storage of materials to be reused on-site, such as wood cut-offs for blocking.
 - b. Separate dumpsters for each category of recyclable.
 - c. Recycling bins at worker lunch area.
 2. Provide containers as required.
 3. Provide temporary enclosures around piles of separated materials to be recycled or salvaged.
 4. Provide materials for barriers and enclosures that are nonhazardous, recyclable, or reusable to the maximum extent possible; reuse project construction waste materials if possible.
 5. Locate enclosures out of the way of construction traffic.
 6. Provide adequate space for pick-up and delivery and convenience to subcontractors.
 7. If an enclosed area is not provided, clearly lay out and label a specific area on-site.
 8. Keep recycling and trash/waste bin areas neat and clean and clearly marked in order to avoid contamination of materials.
- F. Hazardous Wastes: Separate, store, and dispose of hazardous wastes according to applicable regulations.
- G. Recycling: Separate, store, protect, and handle at the site identified recyclable waste products in order to prevent contamination of materials and to maximize recyclability of identified materials. Arrange for timely pickups from the site or deliveries to recycling facility in order to prevent contamination of recyclable materials.
- H. Reuse of Materials On-Site: Set aside, sort, and protect separated products in preparation for reuse.
- I. Salvage: Set aside, sort, and protect products to be salvaged for reuse off-site.

3.03 DISPOSAL OPERATIONS AND WASTE HAULING

- A. Remove waste materials from Project Site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
1. Except for items or materials to be salvaged, recycled, or otherwise reused.
 2. Except as otherwise specified, do not allow waste materials that are to be disposed of to accumulate on site.
 3. Use a permitted waste hauler or Contractor's trucking services and personnel. To confirm valid permitted status of waste haulers, contact the local solid waste authority.
 4. Become familiar with the conditions for acceptance of new construction, excavation and demolition materials at recycling facilities, prior to delivering materials.
 5. Deliver to facilities that can legally accept new construction, excavation and demolition materials for purpose of re-use, recycling, composting, or disposal.
 6. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
 7. Do not burn or bury waste materials on or off site. Appropriate on-site topical application of ground gypsum or wood, or use of site paving as granulated fill is considered reuse, not waste.

3.04 PLAN AND REPORT FORMS

- A. See suggested forms on the following pages.

END OF SECTION

CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN

(Submit After Award of Contract and Prior to Start of Work)

Project Title:						
Contract or Work Order No.:						
Contractor's Name:						
Street Address:						
City:				State:		Zip:
Phone: ()				Fax: ()		
E-Mail Address:						
Prepared by: (Print Name)						
Date Submitted:						
Project Period:		From:			TO:	
Reuse, Recycling or Disposal Processes To Be Used						
Describe the types of recycling processes or disposal activities that will be used for material generated in the project. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:						
01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)						
02 - Salvaging building materials or salvage items at an offsite salvage or re-use center (i.e. lighting, fixtures)						
03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)						
04 - Recycling source separated materials at an offsite recycling center (i.e. scrap metal or green materials)						
05 - Recycling commingled loads of C&D materials at an offsite mixed debris recycling center or transfer station						
06 - Recycling material as Alternative Daily Cover at landfills						
07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).						
08 - Disposal at a landfill or transfer station.						
09 - Other (please describe) _____						
Types of Material To Be Generated						
Use these codes to indicate the types of material that will be generated on the project						
A = Asphalt		C = Concrete		M = Metals		I = Mixed Inert G = Green Materials
D = Drywall		P/C=Paper/Cardboard		W/C = Wire/Cable		S= Soils (Non Hazardous)
M/C = Miscellaneous Construction Debris		R = Reuse/Salvage		W = Wood		O = Other (describe)
Facilities Used: Provide Name of Facility and Location (City)						
Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period						
Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).						
SECTION I - RE-USED/RECYCLED MATERIALS						
Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.						
Type of Material	Type of Activity	Facility to be Used/Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) M	04	ABC Metals, Los Angeles	24	355		
a. Total Diversion						

CONTRACTOR'S CONSTRUCTION WASTE AND RECYCLING PLAN

Continued

SECTION II - DISPOSED MATERIALS						
Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.						
Type of Material	Type of Activity	Facility to be Used/Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) D	08	DEF Landfill, Los Angeles	2	35		
b. Total Disposal				0	0	0

SECTION III - TOTAL MATERIALS GENERATED			
This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)			
	Tons	Cubic YD	Other Wt.
a. Total Reused/Recycled	0	0	0
b. Total Disposed	0	0	0
c. Total Generated	0	0	0

SECTION IV - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION			
Add totals from Section I + Section II			
	Tons	Cubic YD	Other Wt.
a. Materials Re-Used and Recycled	0		
b. Materials Disposed	0		
c. Total Materials Generated (a. + b. = c.)	0	0	0
d. Landfill Diversion Rate (Tonnage Only)*			

* Use tons only to calculate recycling percentages: Tons Reused/Recycled/Tons Generated = % Recycled

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):

Notes:

1. Suggested Conversion Factors: From Cubic Yards to Tons
(Use when scales are not available)

- a. Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
- b. Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)

c. Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)

d. Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)

e. Drywall Scrap: .20

f. Wood Scrap: .16

CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT

(Submit With Each Progress Payment)

Project Title:						
Contract or Work Order No.:						
Contractor's Name:						
Street Address:						
City:				State:		Zip:
Phone: ()				Fax: ()		
E-Mail Address:						
Prepared by: (Print Name)						
Date Submitted:						
Project Period:		From:		TO:		
Reuse, Recycling or Disposal Processes to Be Used						
Describe the types of recycling processes or disposal activities that will be used for material generated in the project. Indicate the type of process or activity by number, types of materials, and estimated quantities that will be recycled or disposed in the sections below:						
01 - Reuse of building materials or salvage items on site (i.e. crushed base or red clay brick)						
02 - Salvaging building materials or salvage items at an offsite salvage or re-use center (i.e. lighting, fixtures)						
03 - Recycling source separated materials on site (i.e. crushing asphalt/concrete for reuse or grinding for mulch)						
04 - Recycling source separated materials at an offsite recycling center (i.e. scrap metal or green materials)						
05 - Recycling commingled loads of C&D materials at an offsite mixed debris recycling center or transfer station						
06 - Recycling material as Alternative Daily Cover at landfills						
07 - Delivery of soils or mixed inerts to an inert landfill for disposal (inert fill).						
08 - Disposal at a landfill or transfer station.						
09 - Other (please describe) _____						
Types of Material To Be Generated						
Use these codes to indicate the types of material that will be generated on the project						
A = Asphalt		C = Concrete		M = Metals		I = Mixed Inert G = Green Materials
D = Drywall		P/C=Paper/Cardboard		W/C = Wire/Cable		S= Soils (Non-Hazardous)
M/C = Miscellaneous Construction Debris		R = Reuse/Salvage		W = Wood		O = Other (describe)
Facilities Used: Provide Name of Facility and Location (City)						
Total Truck Loads: Provide Number of Trucks Hauled from Site During Reporting Period						
Total Quantities: If scales are available at sites, report in tons. If not, quantify by cubic yards. For salvage/reuse items, quantify by estimated weight (or units).						
SECTION I - RE-USED/RECYCLED MATERIALS						
Include all recycling activities for source separated or mixed material recycling centers where recycling will occur.						
Type of Material	Type of Activity	Facility to be Used/Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) M	04	ABC Metals, Los Angeles	24	355		
a. Total Diversion						

CONTRACTOR'S REUSE, RECYCLING, AND DISPOSAL REPORT

Continued

SECTION II - DISPOSED MATERIALS						
Include all disposal activities for landfills, transfer stations, or inert landfills where no recycling will occur.						
Type of Material	Type of Activity	Facility to be Used/Location	Total Truck Loads	Total Quantities		
				Tons	Cubic YD	Other Wt.
(ex.) D	08	DEF Landfill, Los Angeles	2	35		
b. Total Disposal						

SECTION III - TOTAL MATERIALS GENERATED			
This section calculates the total materials to be generated during the project period (Reuse/Recycle + Disposal = Generation)			
	Tons	Cubic YD	Other Wt.
a. Total Reused/Recycled			
b. Total Disposed			
c. Total Generated			

SECTION IV - CONTRACTOR'S LANDFILL DIVERSION RATE CALCULATION			
Add totals from Section I + Section II			
	Tons	Cubic YD	Other Wt.
a. Materials Re-Used and Recycled			
b. Materials Disposed			
c. Total Materials Generated (a. + b. = c.)			
d. Landfill Diversion Rate (Tonnage Only)*			

* Use tons only to calculate recycling percentages: Tons Reused/Recycled/Tons Generated = % Recycled

Contractor's Comments (Provide any additional information pertinent to planned reuse, recycling, or disposal activities):

Notes:

1. Suggested Conversion Factors: From Cubic Yards to Tons
(Use when scales are not available)

- a. Asphalt: .61 (ex. 1000 CY Asphalt = 610 tons. Applies to broken chunks of asphalt)
- b. Concrete: .93 (ex. 1000 CY Concrete = 930 tons. Applies to broken chunks of concrete)

c. Ferrous Metals: .22 (ex. 1000 CY Ferrous Metal = 220 tons)

d. Non-Ferrous Metals: .10 (ex. 1000 CY Non-Ferrous Metals = 100 tons)

e. Drywall Scrap: .20

f. Wood Scrap: .16

SECTION 01 76 10 TEMPORARY PROTECTIVE COVERINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Temporary protective coverings for installed floors, walls, and other surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 01 70 00 - Execution and Closeout Requirements: Coordination of requirements for materials specified in this section.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- B. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board; 2022.
- 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. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films; 2023, with Errata.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes available; and installation instructions.
- C. Shop Drawings: Indicate existing finished surfaces to be protected.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Temporary Protective Coverings:
 - 1. Fortifiber Building Systems Group: fortifiber.com.
 - 2. Protex Products: www.protex-products.com.
 - 3. Surface Shields, Inc: www.surfaceshields.com.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 GENERAL

- A. Provide materials that are easily removed without damage to the surfaces covered and with the following characteristics:
 - 1. Water resistant.
 - 2. Vapor permeable.
 - 3. Impact resistant.
 - 4. Slip resistant.

5. Flame retardant.

2.03 MATERIALS

A. Sheet Materials:

1. Corrugated polypropylene sheet.
2. Recycled paperboard/plastic composite sheet.
3. Recycled paperboard sheet.
4. Wood Hardboard: ANSI A135.4, tempered, 1/4 inch thick nominal.
5. Plywood, 1/2 inch thick nominal.
6. Fiberboard: ASTM C208, 1/2 inch thick nominal.
7. Water Vapor Permeability: Greater than 0.1 perms when tested in accordance with ASTM E96/E96M.
8. Flame Retardance: Meet requirements of NFPA 701.
9. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

B. Rolled Materials:

1. Self-adhering polyethylene film.
2. Recycled cellulose fiberboard paper.
3. Laminated glass fiber reinforced kraft paper.
4. Rosin coated paper.
5. Water Vapor Permeability: Greater than 0.1 perms when tested in accordance with ASTM E96/E96M.
6. Flame Retardance: Meet requirements of NFPA 701.
7. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.

C. Corner and Door Jamb Protection Materials:

1. Cardboard, shaped specifically for application.
2. PVC plastic.

D. Tape: Type recommended by protective covering material manufacturer.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove dirt and debris from surfaces to be protected.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Trim or overlap sheet materials to fit area to be covered.
- C. Roll out and cut rolled materials to fit area to be covered.
- D. Tape seams. Avoid taping directly to finished surfaces.
- E. Stretch self-adhering film materials to completely cover surface.
- F. Install door jamb protection to full height of opening.

- G. Position corner protection 4 inches above finished floor to 96 inches high.

3.03 REMOVAL

- A. Remove protective coverings prior to Date of Final Inspection. Reuse or recycle materials if possible.

END OF SECTION

SECTION 01 78 00 CLOSEOUT SUBMITTALS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Project record documents.
- B. Operation and maintenance data.
- C. Warranties and bonds.

1.02 RELATED REQUIREMENTS

- A. District issued Bidding Instructions and Contract General Conditions: Performance bond and labor and material payment bonds, warranty, and correction of work.
- B. Section 01 30 00 - Administrative Requirements: Submittals procedures, shop drawings, product data, and samples.
- C. Section 01 45 33 - Code-Required Special Inspections: Construction oversight procedures by DSA regarding the execution, approval, and closeout of this building project.
- D. Section 01 70 00 - Execution and Closeout Requirements: Contract closeout procedures.
- E. Section 01 78 39 - Project Record Documents: Detailed requirements.
- F. Individual Product Sections: Specific requirements for operation and maintenance data.
- G. Individual Product Sections: Warranties required for specific products or Work.
 - 1. Special Project warranty requirements for specific products or elements of the Work; commitments and agreements for continuing services to District.

1.03 DEFINITIONS

- A. Warranty: Assurance to District by Contractor, installer, supplier, manufacturer or other party responsible as warrantor, for the quantity, quality, performance and other representations of a product, system service of the Work, in whole or in part, for the duration of the specified period of time.
- B. Guarantee: Assurance to District by Contractor or product manufacturer or other specified party, as guarantor, that the specified warranty will be fulfilled by the guarantor in the event of default by the warrantor.
- C. Standard Product Warranty: Preprinted, written warranty published by product manufacturer for particular products and specifically endorsed by the manufacturer to the District.
- D. Special Project Warranty: Written warranty required by or incorporated into Contract Documents, to extend time limits provided by standard warranty or to provide greater rights for District.
- E. Correction Period: As defined in the Conditions of the Contract, Correction Period shall be synonymous with "warranty period", "guarantee period" and similar terms used in the Contract Specifications.

1.04 SUBMITTALS

- A. Advance Submittals: For equipment and systems, or component parts of systems, put into service during construction and operated by District, submit documents within ten days of start of operation by District.

- B. Final Completion Submittals: Prior to application for final payment, Contractor shall submit 3 copies the following:
1. Agency Document Submittals: Submit to District all documents required by authorities having jurisdiction, including serving utilities and other agencies. Submit original versions of all permit cards, with final sign-off by inspectors. Submit all certifications of inspections and tests.
 - a. Complete all required Contractor forms and obtain DSA approval of these same forms. Comply with "Final Certification of Construction" per Title 24 Part 1 section 4-339.
 - 1) Form-6.C: Verified Report – Contractor: From each Contractor having a contract with the District.
 2. Final Specifications Submittals: Submit to District all documents and products required by Specifications to be submitted, including the following:
 - a. Project record drawings and specifications.
 - b. Operating and maintenance data.
 - c. Guarantees, warranties and bonds.
 - d. Keys and keying schedule.
 - e. Spare parts and extra stock.
 - f. Test reports and certificates of compliance.
 3. Certificates of Compliance and Test Report Submittals: Submit to District certificates and reports as specified and as required by authorities having jurisdiction, including the following:
 - a. Sterilization of water systems.
 - b. Sanitary sewer system tests.
 - c. Gas system tests.
 - d. Lighting, power and signal system tests.
 - e. Ventilation equipment and air balance tests.
 - f. Fire sprinkler system tests.
 - g. Fire detection system, smoke alarms and dampers.
 - h. Roofing inspections and tests.
 4. Lien and Bonding Company Releases: Submit to District, with copy to Architect, evidence of satisfaction of encumbrances on Project by completion and submission of The American Institute of Architects Forms:
 - a. G706 - Contractor's Affidavit of Payment of Debts and Claims;
 - b. G706A - Contractor's Affidavit of Release of Liens;
 - c. (if applicable) G707 - Consent of Surety;
 - d. or forms as as agreed to by the District.
 - e. Comply also with other requirements of District, as directed.
 - f. All signatures shall be notarized.
 5. Subcontractor List: Submit to two copies to District and two copies to Architect of updated Subcontractor and Materials Supplier List.
 6. Warranty Documents: Prepare and submit to District all warranties and bonds as specified in Contract General Conditions and this Section.
- C. Project Record Documents: Submit final progress markup PDF documents by uploading via Bluebeam to Architect with claim for final Application for Payment.
- D. Operation and Maintenance Data:

1. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect will review draft and return one copy with comments.
 2. For equipment, or component parts of equipment put into service during construction and operated by District, submit completed documents within ten days after acceptance.
 3. Submit one copy of completed documents 15 days prior to final inspection. This copy will be reviewed and returned after final inspection, with Architect comments. Revise content of all document sets as required prior to final submission.
 4. Submit two sets of revised final documents in final form within 10 days after final inspection.
- E. Warranties and Bonds:
1. For equipment or component parts of equipment put into service during construction with District's permission, submit documents within 10 days after acceptance.
 2. Make other submittals within 10 days after Date of Final Inspection, prior to final Application for Payment.
 3. For items of Work for which acceptance is delayed beyond Date of Final Inspection, submit within 10 days after acceptance, listing the date of acceptance as the beginning of the warranty period.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 PROJECT RECORD DOCUMENTS

- A. See also Section 01 78 39 - Project Record Documents.
- B. Record Documents are to be maintained and submitted in searchable live electronic format (PDF), unflattened.
1. Develop in compliance with Section 01 30 00 - Administrative Requirements.
 2. Acceptable markup software:
 - a. Adobe Acrobat Professional.
 - b. Bluebeam Revu.
- C. Maintain on site one set of the following record documents; record actual revisions to the Work:
1. Contract Drawings.
 2. Project Manual with Specifications.
 3. Addenda.
 4. Change Orders and other modifications to the Contract.
 5. Reviewed shop drawings, product data, and samples.
 6. Manufacturer's instruction for assembly, installation, and adjusting.
- D. Ensure entries are complete and accurate, enabling future reference by District.
- E. Store record documents separate from documents used for construction.
- F. Record information concurrent with construction progress.
- G. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:

1. Manufacturer's name and product model and number.
 2. Product substitutions or alternates utilized.
 3. Changes made by Addenda and modifications.
 4. Provide copies of all approved addenda, directives, corrections, and change orders affecting the associated project.
 - a. These copies shall be included with the "Bid Set" and/or "Record Set" listed above and formatted as detailed above.
- H. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Reproducible (PDF) set of Contract Drawings will be provided to Contractor by District through Architect or Construction Manager.
 2. Measured depths of foundations in relation to finish first floor datum.
 3. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 4. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
 5. Field changes of dimension and detail.
 6. Details not on original Contract drawings.
 - a. Application of copies of details produced and provided by Architect during construction will be accepted.
 7. Sketches, clarifications (RFI's), Field Orders, Supplemental Instructions, Construction Change Documents, and Approved Change Orders
- I. Submission: Submit by uploading, Record Documents to Architect prior to each Application for Payment.
1. Provide, by email, to the Architect, a download link the Record Documents consisting of an unflattened PDF format with live text and redline mark-ups, not scanned.
 2. Maintain one additional paper copy and one in PDF format (on CD) of the fire suppression and fire protection detection system drawings and specifications at the building premises.
 - a. One copy is to be kept on site for a period of three years to comply with CFC section 901.6.2.

3.02 OPERATION AND MAINTENANCE DATA

- A. Source Data: For each product or system, list names, addresses and telephone numbers of Subcontractors and suppliers, including local source of supplies and replacement parts.
- B. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.
- C. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Do not use Project Record Documents as maintenance drawings.
- D. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.

3.03 OPERATION AND MAINTENANCE DATA FOR MATERIALS AND FINISHES

- A. For Each Product, Applied Material, and Finish:

1. Product data, with catalog number, size, composition, and color and texture designations.
2. Information for re-ordering custom manufactured products.
- B. Instructions for Care and Maintenance: Manufacturer's recommendations for cleaning agents and methods, precautions against detrimental cleaning agents and methods, and recommended schedule for cleaning and maintenance.
- C. Moisture protection and weather-exposed products: Include product data listing applicable reference standards, chemical composition, and details of installation. Provide recommendations for inspections, maintenance, and repair.
- D. Additional information as specified in individual product specification sections.
- E. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.

3.04 OPERATION AND MAINTENANCE DATA FOR EQUIPMENT AND SYSTEMS

- A. For Each Item of Equipment and Each System:
 1. Description of unit or system, and component parts.
 2. Identify function, normal operating characteristics, and limiting conditions.
 3. Include performance curves, with engineering data and tests.
 4. Complete nomenclature and model number of replaceable parts.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific products.
- C. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by label machine.
- D. Include color coded wiring diagrams as installed.
- E. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
- F. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 1. Include HVAC outdoor and exhaust air damper calibration strategy.
 - a. Include provisions which ensure that full closure of dampers can be achieved.
 2. Include Carbon Dioxide Monitoring Protocol.
- G. Provide servicing and lubrication schedule, and list of lubricants required.
- H. Include manufacturer's printed operation and maintenance instructions.
- I. Include sequence of operation by controls manufacturer.
- J. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- K. Provide control diagrams by controls manufacturer as installed.
- L. Provide Contractor's coordination drawings, with color coded piping diagrams as installed.
- M. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

- N. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - 1. Parts Data:
 - a. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams as necessary for service and maintenance.
 - b. Include complete nomenclature and catalog numbers for consumable and replacement parts.
 - c. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in stock by the District or operator.
- O. Include test and balancing reports.
- P. Additional Requirements: As specified in individual product specification sections.

3.05 ASSEMBLY OF OPERATION AND MAINTENANCE MANUALS

- A. Assemble operation and maintenance data into durable manuals for District's personnel use, with data arranged in the same sequence as, and identified by, the specification sections.
 - 1. Provide duplicate electronic formatted (PDF) versions of the O&M binder for record purposes. Organize the same as the printed versions.
- B. Where systems involve more than one specification section, provide separate tabbed divider for each system.
- C. Binders: Commercial quality, 8-1/2 by 11 inch three D side ring binders with durable plastic covers; 2 inch maximum ring size. When multiple binders are used, correlate data into related consistent groupings.
- D. Cover: Identify each binder with typed or printed title OPERATION AND MAINTENANCE INSTRUCTIONS; identify title of Project; identify subject matter of contents.
- E. Project Directory: Title and address of Project; names, addresses, and telephone numbers of Architect, Consultants, Contractor and subcontractors, with names of responsible parties.
- F. Tables of Contents: List every item separated by a divider, using the same identification as on the divider tab; where multiple volumes are required, include all volumes Tables of Contents in each volume, with the current volume clearly identified.
- G. Dividers: Provide tabbed dividers for each separate product and system; identify the contents on the divider tab; immediately following the divider tab include a description of product and major component parts of equipment.
- H. Text: Manufacturer's printed data, or typewritten data on 20 pound paper.
- I. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- J. Arrangement of Contents: Organize each volume in parts as follows:
 - 1. Project Directory.
 - 2. Table of Contents, of all volumes, and of this volume.
 - 3. Operation and Maintenance Data: Arranged by system, then by product category.
 - a. Source data.
 - b. Product data, shop drawings, and other submittals.
 - c. Operation and maintenance data.
 - d. Field quality control data.
 - e. Photocopies of warranties and bonds.

4. Design Data: To allow for addition of design data furnished by Architect or others, provide a tab labeled "Design Data" and provide a binder large enough to allow for insertion of at least 20 pages of typed text.

3.06 WARRANTIES AND BONDS

A. General:

1. Provide all warranties and guarantees with District named as beneficiary.
2. For equipment and products, or components thereof, bearing a manufacturer's warranty or guarantee that extends for a period of time beyond the Contractor's warranty and guarantee, so state in the warranty or guarantee.

B. General Warranty and Guarantee Requirements:

1. Warranty shall be an agreement to repair or replace, without cost and undue hardship to District, Work performed under the Contract which is found to be defective during the Correction Period (warranty or guarantee) period.
2. Repairs and replacements due to improper maintenance or operation, or due to normal wear, usage and weathering are excluded from warranty requirements unless otherwise specified.

C. Provisions for Special Warranties: Refer to Conditions of the Contract for terms of the Contractor's special warranty of workmanship and materials.

D. Specific Warranty and Guarantee Requirements: Specific requirements are included in product Specifications Technical Sections, including content and limitations.

E. Disclaimers and Limitations:

1. Manufacturer's disclaimers and limitations on product warranties and guarantees shall not relieve Contractor of responsibility for warranty and guarantee requirements.
2. This applies to the Work that incorporates such products, nor shall they relieve suppliers, manufacturers, and installers required to countersign special warranties with Contractor.

F. Related Damages and Losses: When correcting warranted Work that has been found defective, remove and replace other Work that has been damaged as a result of such defect or that must be removed and replaced to provide access for correction of warranted Work.

G. Reinstatement of Warranty:

1. When Work covered by a warranty has been found defective and has been corrected by replacement or rebuilding, reinstate the warranty by written endorsement.
2. The reinstated warranty shall be equal to the original warranty with an equitable adjustment for depreciation.

H. Replacement Cost:

1. Upon determination that Work covered by a warranty has been found to be defective, replace or reconstruct the Work to a condition acceptable to District, complying with applicable requirements of the Contract Documents.
2. Contractor is responsible for all costs for replacing or reconstructing defective Work regardless of whether District has benefited from use of the Work through a portion of its anticipated useful service life.

I. District's Recourse:

1. Written warranties made to the District are in addition to implied warranties, and do not limit the duties, obligations, rights and remedies otherwise available under law, nor shall warranty periods be interpreted as limitations on time in which the District can enforce such other duties, obligations, rights, or remedies.

2. Rejection of Warranties:
 - a. The District reserves the right to reject warranties and to limit selections to products with warranties not in conflict with requirements of the Contract Documents.
- J. Warranty as Condition of Acceptance:
 1. District reserves the right to refuse to accept Work for the Project where a special warranty, certification, or similar commitment shall be required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.
- K. Obtain warranties and bonds, executed in duplicate by responsible Subcontractors, suppliers, and manufacturers, within 10 days after completion of the applicable item of work. Except for items put into use with District's permission, leave date of beginning of time of warranty until Date of Final Acceptance is determined.
- L. Project Warranty and Guarantee Forms:
 1. Example forms for special Project warranties and guarantees are included at the end of this Section.
 2. Prepare written documents utilizing the appropriate form, ready for execution by the Contractor, or the Contractor and subcontractor, supplier or manufacturer.
 - a. Submit a draft to District through Architect for approval prior to final execution.
 3. Refer to product Technical Specifications Sections for specific content requirements, and particular requirements for submittal of special warranties.
 4. Prepare standard warranties and guarantees, excepting manufacturers' standard printed warranties and guarantees, on Contractor's, subcontractor's, material supplier's, or manufacturer's own letterhead, addressed to District.
 5. Warranty and guarantee letters shall be signed by all responsible parties and by Contractor in every case, with modifications only as approved in advance by District to suit the conditions pertaining to the warranty or guarantee.
- M. Manufacturer's Guarantee Form:
 1. Manufacturer's guarantee form may be used in lieu of special Project form included at the end of this Section.
 2. Manufacturer's guarantee form shall contain appropriate terms and identification, ready for execution by the required parties.
 3. If proposed terms and conditions restrict guarantee coverage or require actions by District beyond those specified, submit draft of guarantee to District through Architect for review and acceptance before performance of the Work.
 4. In other cases, submit draft of guarantee to District through Architect for approval prior to final execution of guarantee.
- N. Verify that documents are in proper form, contain full information, and are notarized.
 1. Provide all warranties and guarantees with District named as beneficiary.
 2. Signatures: By person authorized to sign warranties, guarantees and bonds on behalf of entity providing such warranty, guarantee or bond.
 3. Co-Signature: All installer's warranties and bonds shall be co-signed by Contractor. Manufacturer's guarantees will not require co-signature.
- O. Co-execute submittals when required.
- P. Retain warranties and bonds until time specified for submittal.

- Q. Manual: Bind in commercial quality 8-1/2 by 11 inch three D side ring binders with durable plastic covers.
- R. Cover: Identify each binder with typed or printed title WARRANTIES AND BONDS, with title of Project; name, address and telephone number of Contractor and equipment supplier; and name of responsible company principal.
 - 1. If more than one volume of warranties, guarantees and bonds is produced, identify volume number on binder.
- S. Table of Contents: Neatly typed, in the sequence of the Table of Contents of the Project Manual, with each item identified with the number and title of the specification section in which specified, and the name of product or work item.
- T. Separate each warranty or bond with index tab sheets keyed to the Table of Contents listing. Provide full information, using separate typed sheets as necessary. List Subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
- U. Form of Warranty and Bond Submittals:
 - 1. Prior to final Application and Certificate for Payment, compile two copies of each required warranty, guarantee and bond, properly executed by Contractor, or jointly by Contractor, subcontractor, supplier, or manufacturer.
 - 2. Collect and assemble all written warranties and guarantees into binders and deliver binders to District for final review and acceptance.
 - 3. Include Table of Contents for binder, neatly typed, following order and Section numbers and titles as used in the Project Manual.
 - 4. Provide heavy paper dividers with celluloid or plastic covered tabs for each separate warranty.
 - a. Mark tabs to identify products or installation, and Section number and title.
 - 5. Include on separate typed sheet, if information is not contained in warranty or guarantee form, a description of the product or installation, and the name, address, telephone number and responsible person for applicable installer, supplier and manufacturer.
 - 6. When operating and maintenance data manuals are required for warranted construction, include additional copies of each required warranty and guarantee in each required manual.
 - a. Coordinate with requirements listed in the prior articles for operating and maintenance data manuals.

3.07 TIME OF WARRANTY AND BOND SUBMITTALS

- A. Submission of Preliminary Copies:
 - 1. Unless otherwise specified, obtain preliminary copies of warranties, guarantees and bonds within ten days of completion of applicable item or Work.
 - 2. Prepare and submit preliminary copies for review as specified herein.
- B. Submission of Final Copies:
 - 1. Submit fully executed copies of warranties, guarantees and bonds within ten days of date identified in Certificate of Completion but no later than three days prior to date of final Application for Payment.
- C. Date of Warranties and Bonds:
 - 1. Unless otherwise directed or specified, commencement date of warranty, guarantee and bond periods shall be the date established in the Certificate of Completion.

2. Warranties for Work accepted in advance of date stated in Certificate of Completion:
 - a. When a designated system, equipment, component parts or other portion of the Work is completed and occupied or put to beneficial use by District:
 - 1) By separate agreement with Contractor, prior to completion date established in the Certificate of Completion, submit properly executed warranties to District within ten days of completion of that designated portion of the Work.
 - 2) List date of commencement of warranty, guarantee or bond period as the date established in the Certificate of Completion.
3. Warranties for Work not accepted as of date established in the Certificate of Completion:
 - a. Submit documents within ten days after acceptance, listing date of acceptance as beginning of warranty, guarantee or bond period.
- D. Duration of Warranties and Guarantees:
 1. Unless otherwise specified or prescribed by law, warranty and guarantee periods shall be not less than the Correction Period required by the Conditions of the Contract.
 2. In no case, the period is to be less than one year from the date established for completion of the Project in the Certificate of Completion.
 3. See product Specifications Sections of the Project Manual for extended warranty and guarantee beyond the minimum one year duration.

END OF SECTION

**SECTION 01 78 00.01
WARRANTY FORM LETTER**

**FOR CONTRACTOR'S / SUBCONTRACTOR'S / MANUFACTURER'S WARRANTY
CONTRACTOR'S/SUBCONTRACTOR'S/SUPPLIER'S LETTERHEAD**

SPECIAL LIMITED PROJECT WARRANTY FOR _____ WORK.

We, the undersigned, do hereby warrant that the portion of the Work described above which we have provided for Battles ES - TK-K Building and Site Upgrades is in accordance with the Contract Documents and that all such Work as installed will fulfill or exceed all minimum warranty requirements. We agree to repair or replace Work installed by us, together with any adjacent Work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or function within a period of (years), commencing (date identified in Certificate of Completion, unless otherwise directed) and terminating (date).

The following terms and conditions apply to this warranty (obtain District 's approval before submission):

In the event of our failure to comply with the above-mentioned conditions within a reasonable time period determined by the District , after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the District to have said defective Work repaired or replaced to be made good, and agree to pay to the District upon demand all moneys that the District may expend in making good said defective Work, including all collection costs and reasonable attorney fees.

**LOCAL REPRESENTATIVE: FOR WARRANTY MAINTENANCE, REPAIR, OR
REPLACEMENT SERVICE, CONTACT:**

(Name) _____
(Address) _____
(City) _____ (State) _____ (ZIP) _____
(Phone) _____ / _____
(signed) _____
(Typed Name) _____ (Date) _____
(Title) _____ (Firm) _____

CONTRACTOR:

State License No: _____
(signed) _____
(Date) _____ (Typed Name) _____
(Title) _____ (Firm) _____

FORM LETTER

**FOR CONTRACTOR'S / MANUFACTURER'S GUARANTEE
CONTRACTOR'S / MANUFACTURER'S LETTERHEAD**

We, the undersigned, do hereby [warrant] [guarantee] that the portion of the Work described above which [we have provided] [was provided by (Installer or Subcontractor's Name)] for Battles ES - TK-K Building and Site Upgrades in accordance with the Contract Documents and that all such Work as installed will fulfill or exceed all minimum warranty requirements. We agree to repair or replace Work installed by [us,] [(Installer or Subcontractor's Name)] together with any adjacent Work which is displaced or damaged by so doing, that proves to be defective in workmanship, material, or function within a period of (years), commencing (date indicated in Certificate of Completion, unless otherwise directed) and terminating (date).

In the event of our failure to comply with the above-mentioned conditions within a reasonable time period determined by the District, after notification in writing, we, the undersigned, all collectively and separately, hereby authorize the District to have said defective Work repaired or replaced to be made good, and agree to pay to the District upon demand all moneys that the District may expend in making good said defective Work, including all collection costs and reasonable attorney fees.

(Name) _____

(Address) _____

(City) _____ (State) _____ (ZIP) _____

(Phone) _____ / _____

(signed) _____

(Date) _____ (Typed Name) _____

(Title) _____ (Firm) _____

State License No: _____
 (signed) _____
 (Date) _____ (Typed Name) _____
 (Title) _____ (Firm) _____

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SECTION 01 78 39 PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 SUMMARY

- A. Record Drawings.
- B. Record Specifications.
- C. Record Product Data.
- D. Record Samples.
- E. Record Photos and Video.
- F. Miscellaneous record submittals.

1.02 RELATED REQUIREMENTS:

- A. Section 01 20 00 - Price and Payment Procedures: Schedule of Values.
- B. Section 01 30 00 - Administrative Requirements: Project Coordination.
- C. Section 01 78 00 - Closeout Submittals: General Closeout.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Recorded actual locations.

PART 2 -PRODUCTS - NOT USED

PART 3 - EXECUTION

3.01 RECORD DRAWINGS

- A. Record Documents: Maintain one set of marked-up PDF copies of the Contract Drawings and Shop Drawings, incorporating new and revised drawings as modifications are issued.
 - 1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an acceptable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
 - e. Cross-reference record prints to corresponding archive photographic documentation.
 - 2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Field changes of dimensions from Drawings.
 - b. Revisions to details shown on Drawings.

- 1) Details not on original Contract Drawings. Application of copies of details produced and provided by Architect during construction will be accepted.
- c. Depths of foundations and footing, measured in relation to finish First Floor datum.
- d. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent ground improvements.
- e. Revisions to routing of piping and conduits.
- f. Revisions to electrical circuits.
- g. Actual equipment locations and sizes.
- h. Duct size and routing.
- i. Locations of concealed internal utilities.
- j. Permanent Room names and Room numbers.
- k. Changes made by Change Order or Construction Change Directive.
- l. Changes made following written orders by District or Construction Manager.
- m. Changes made following Architect's written orders.
- n. Note clarifications from RFI's.
- o. Field records for variable and concealed conditions.
- p. Record information on the Work that is shown only schematically.
3. Mark the Contract Drawings and Shop Drawings completely and accurately. Use personnel proficient at recording graphic information in production of marked-up record prints.
4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
5. Mark important additional information that was either shown schematically or omitted from original Drawings.
6. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Architect. When authorized, prepare a full set of corrected digital data files of the Contract Drawings, as follows:
 1. Format: Same digital data software program, version, and operating system as the original Contract Drawings.
 - a. Format: DWG, Version, Microsoft Windows operating system.
 2. Incorporate changes and additional information previously marked on record prints. Delete, redraw, and add details and notations where applicable.
 3. Refer instances of uncertainty to Architect and Construction Manager for resolution.
 4. Architect will furnish Contractor one set of digital data files of the Contract Drawings for use in recording information.
 - a. See Section 01 35 50 - Requests for Electronic Files for requirements related to use of Architect's digital data files.
 - b. Architect will provide data file layer information. Record markups in separate layers.
- C. Newly Prepared Record Drawings: Prepare new Drawings instead of preparing record Drawings where Architect determines that neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation.

1. New Drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 2. Consult Architect and Construction Manager for proper scale and scope of detailing and notations required to record the actual physical installation and its relation to other construction. Integrate newly prepared record Drawings into record Drawing sets; comply with procedures for formatting, organizing, copying, binding, and submitting.
- D. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location.
1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 2. Format: Annotated PDF electronic file with comment function enabled.
 3. Record Digital Data Files: Organize digital data information into separate electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 4. Identification:
 - a. Project name and number.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Architect and Construction Manager.
 - e. Name of Contractor.

3.02 RECORD SPECIFICATIONS

- A. Preparation: Mark Specifications in PART 2 to indicate the actual product installation where installation varies from that indicated in Specifications, addenda, and contract modifications.
1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 2. Mark copy with the proprietary name and model number of products, materials, and equipment furnished, including substitutions and product options selected.
 3. Record the name of manufacturer, supplier, Installer, and other information necessary to provide a record of selections made.
 4. For each principal product, indicate whether record Product Data has been submitted in operation and maintenance manuals instead of submitted as record Product Data.
 5. Note related Change Orders, record Product Data, and Record Drawings, where applicable.
- B. Format: Submit record Specifications as annotated PDF electronic file.

3.03 RECORD DESIGN AND ENGINEERING DATA

- A. Fire Systems:
1. Provide updated SDU files at each:
 - a. One flash drive placed inside fire panel cabinet.
 - b. One flash drive turned over to District.
 - c. One file copy emailed Operations and Facilities Director or District.

3.04 RECORD PRODUCT DATA

- A. Preparation: Mark Product Data to indicate the actual product installation where installation varies substantially from that indicated in Product Data submittal.
 - 1. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
 - 2. Include significant changes in the product delivered to Project site and changes in manufacturer's written instructions for installation.
 - 3. Note related Change Orders, record Specifications, and record Drawings where applicable.
- B. Format: Submit record Product Data as annotated PDF electronic file.
 - 1. Include record Product Data directory organized by Specification Section number and title, electronically linked to each item of record Product Data.

3.05 RECORD SAMPLES

- A. Immediately before date of Substantial Completion, meet with District or Construction Manager at Project site to determine which Samples maintained during the construction period are to be transmitted to District or Construction Manager for record purposes.
- B. Comply with District or Construction Manager's instructions for packaging, identification, marking, and delivery to District or Construction Manager's Sample storage space. Dispose of other Samples in the manner specified for disposing surplus and waste materials

3.06 RECORD PHOTOS AND VIDEO

- A. Photograph all work before covering up, including:
 - 1. All open trenches and manholes shall be photographed.
 - 2. All exposed utilities should be identified in the photos.
 - 3. Show photograph locations and dates on Record Drawings.
- B. Interior video recording of all underground sewer and storm drain lines, under the building and outside to and including the on-site or utility connection.

3.07 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.
 - 1. Field records on excavations and foundations.
 - 2. Field records on underground construction and similar work.
 - 3. Surveys showing locations and elevations of underground lines.
 - 4. Invert elevations of drainage piping.
 - 5. Surveys establishing building lines and levels.
 - 6. Authorized measurements using unit prices or allowances.
 - 7. Records of plant treatment.
 - 8. Ambient and substrate condition tests.
 - 9. Certifications received in lieu of labels on bulk products.
 - 10. Batch mixing and bulk delivery records.
 - 11. Testing and qualification of trade persons.

12. Documented qualification of installation firms.
 13. Load and performance testing.
 14. Inspections and certifications by governing authorities.
 15. Leakage and water-penetration tests.
 16. Fire-resistance and flame-spread test results.
 17. Final inspection and correction procedures.
- B. Format: Submit miscellaneous record submittals as PDF electronic file.
1. Include miscellaneous record submittals directory organized by Specification Section number and title, electronically linked to each item of miscellaneous record submittals.

3.08 SUBMISSION

- A. Keep Project Record Documents current, as they will be reviewed for completeness by Architect, Engineer, Project Inspector, and Construction Manager; as a condition of certification for each Progress Payment Application.
- B. Prior to the date of the Notice of Completion, submit marked Record Documents to Architect and Construction Manager for review, approval and further processing.

3.09 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and revisions to project record documents as they occur; do not wait until end of Project.
- B. Review of documents by Architect, Engineer, Project Inspector, or Construction Manager to be in concert with approval of the monthly Application for Payment.
- C. Maintenance of Record Documents and Samples:
1. Store record documents and Samples in the field office apart from the Contract Documents used for construction.
 2. Do not use project record documents for construction purposes.
 3. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss.
 4. Provide access to project record documents for Architect and Construction Manager reference during normal working hours.

END OF SECTION

SECTION 01 79 00 DEMONSTRATION AND TRAINING

PART 1 GENERAL

1.01 SUMMARY

- A. Demonstration of products and systems where indicated in specific specification sections.
- B. Training of District personnel in operation and maintenance is required for:
 - 1. All software-operated systems.
 - 2. Landscape irrigation.
 - 3. Additional systems as requested by District.
 - 4. Items specified in individual product Sections.
- C. Training of District personnel in care, cleaning, maintenance, and repair is required for:
 - 1. Roofing, waterproofing, and other weather-exposed or moisture protection products.
 - 2. Finishes, including flooring, wall finishes, ceiling finishes.
 - 3. Fixtures and fittings.
 - 4. Items specified in individual product Sections.
 - 5. Additional systems as requested by District.

1.02 RELATED REQUIREMENTS

- A. Section 01 78 00 - Closeout Submittals: Operation and maintenance manuals.
- B. Other Specification Sections: Additional requirements for demonstration and training.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Training Plan: District will designate personnel to be trained; tailor training to needs and skill-level of attendees.
 - 1. Each Sub, Design-Builder SubContractor and vendor responsible for training submits a written training plan to the Architect, District, and Construction Manager for review and approval prior to training.
 - 2. Submit to Architect for transmittal to District.
 - 3. Submit not less than four weeks prior to start of training.
 - 4. Revise and resubmit until acceptable.
 - 5. Provide an overall schedule showing all training sessions.
 - 6. Include at least the following for each training session:
 - a. Identification, date, time, and duration.
 - b. Description of products and/or systems to be covered.
 - 1) Equipment list
 - c. Name of firm and person conducting training; include qualifications.
 - d. Intended audience, such as job description.
 - e. Objectives of training and suggested methods of ensuring adequate training.

- 1) Agenda and subjects (design intent, equipment inspections, modes of operation, system interactions, troubleshooting, preventative maintenance, etc.)
 - f. Methods to be used, such as classroom lecture, live demonstrations, hands-on, etc.
 - g. Media to be used, such as slides, hand-outs, etc.
 - 1) The approved O&M manuals shall be used during the training for equipment specific references.
 - h. Training equipment required, such as projector, projection screen, etc., to be provided by Contractor.
- C. Training Manuals: Provide training manual for each attendee; allow for minimum of two attendees per training session.
 1. Include applicable portion of O&M manuals.
 2. Include copies of all hand-outs, slides, overheads, video presentations, etc., that are not included in O&M manuals.
 3. Provide one extra copy of each training manual to be included with operation and maintenance data.
- D. Training Reports:
 1. Identification of each training session, date, time, and duration.
 2. Sign-in sheet showing names and job titles of attendees.
 3. List of attendee questions and written answers given, including copies of and references to supporting documentation required for clarification; include answers to questions that could not be answered in original training session.
- E. Video Recordings: Submit digital video recording of each demonstration and training session for District's subsequent use.
 1. Format: DVD Disc, USB Flash drive, and/or cloud access.
 2. Label each with session identification and date.
 3. Edit training video so that the content is comprehensive and cohesive.

1.04 QUALITY ASSURANCE

- A. Instructor Qualifications: Familiar with design, operation, maintenance and troubleshooting of the relevant products and systems.
 1. Provide as instructors the most qualified trainer of those contractors and/or installers who actually supplied and installed the systems and equipment.
 2. Where a single person is not familiar with all aspects, provide specialists with necessary qualifications.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 TRAINING OF OWNER PERSONNEL

- A. The Contractor and Design-Builder SubContractors shall be responsible for training coordination and scheduling and for ensuring that training is completed.
- B. The Commissioning Authority (CA) shall be responsible for reviewing and approving the content of the training of Owner personnel for commissioned equipment.

- C. The specific training requirements of District personnel by Subs, Design-Builder SubContractors and vendors is specified in the Division in which the equipment is specified.
- D. For primary HVAC equipment, the Controls Contractor shall provide a short discussion of the control of the equipment during the mechanical or electrical training conducted by others.

3.02 DEMONSTRATION - GENERAL

- A. Demonstrations conducted during system start-up do not qualify as demonstrations for the purposes of this section, unless approved in advance by District.
- B. Demonstration may be combined with District personnel training if applicable.
- C. Operating Equipment and Systems: Demonstrate operation in all modes, including start-up, shut-down, seasonal changeover, emergency conditions, and troubleshooting, and maintenance procedures, including scheduled and preventive maintenance.
 - 1. Perform demonstrations not less than two weeks prior to Final Inspection.
 - 2. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.
- D. Non-Operating Products: Demonstrate cleaning, scheduled and preventive maintenance, and repair procedures.
 - 1. Perform demonstrations not less than two weeks prior to Final Inspection.

3.03 TRAINING - GENERAL

- A. Conduct training on-site unless otherwise indicated.
- B. District will provide classroom and seating at no cost to Contractor.
- C. Provide training in minimum two hour segments.
- D. Training schedule will be subject to availability of District's personnel to be trained; re-schedule training sessions as required by District; once schedule has been approved by District failure to conduct sessions according to schedule will be cause for District to charge Contractor for personnel "show-up" time.
- E. Review of Facility Policy on Operation and Maintenance Data: During training discuss:
 - 1. The location of the O&M manuals and procedures for use and preservation; backup copies.
 - 2. Typical contents and organization of all manuals, including explanatory information, system narratives, and product specific information.
 - 3. Typical uses of the O&M manuals.
- F. Product- and System-Specific Training:
 - 1. Review the applicable O&M manuals.
 - 2. For systems, provide an overview of system operation, design parameters and constraints, and operational strategies.
 - 3. Review instructions for proper operation in all modes, including start-up, shut-down, seasonal changeover and emergency procedures, and for maintenance, including preventative maintenance.
 - 4. Provide hands-on training on all operational modes possible and preventive maintenance.
 - 5. Emphasize safe and proper operating requirements; discuss relevant health and safety issues and emergency procedures.
 - 6. Discuss common troubleshooting problems and solutions.
 - 7. Discuss any peculiarities of equipment installation or operation.

8. Discuss warranties and guarantees, including procedures necessary to avoid voiding coverage.
 9. Review recommended tools and spare parts inventory suggestions of manufacturers.
 10. Review spare parts and tools required to be furnished by Contractor.
 11. Review spare parts suppliers and sources and procurement procedures.
- G. Be prepared to answer questions raised by training attendees; if unable to answer during training session, provide written response within three days.

END OF SECTION

SECTION 01 84 13 INTERIOR ACOUSTICAL PERFORMANCE

PART 1 GENERAL

1.01 SCOPE

- A. Prevention of rattling of the construction in response to acoustical excitation.
 - 1. These requirements apply for rooms that accommodate amplified sound play-back.
 - a. Auditoriums.
 - b. Main Lobby
 - c. Multi-Purpose rooms.
 - d. Library
 - e. Classrooms.
 - f. Music Classroom
- B. Rattling noise is most usually generated by two hard surfaces being allowed to vibrate against one another. Common sources of rattles include, but are not limited to, the following:
 - 1. Loosely fitting metal framing.
 - 2. Metal conduit against metal framing.
 - 3. Loosely fitting ceiling grid.
 - 4. Loose joints in air grilles.
 - 5. Loose joints in light fixtures.
 - 6. Loose fitting air conditioning ductwork and duct fittings
 - 7. Lightly damped large metal panels

1.02 RESPONSIBILITY

- A. Ensure that no sound is audible in the completed room from rattling or ringing of any aspect of the construction during normal usage of the room for sound play back, or from a slowly swept sine wave at 95dB from 20Hz to 1kHz.
- B. If the Contractor considers that any aspect of the design, including types of fixtures and fittings specified, will prevent the achievement of a rattle and ringing-free environment then it is the Contractor's responsibility to bring such items to the attention of the Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.01 RECOMMENDED CONSTRUCTION TECHNIQUES

- A. Take great care in the construction process to eliminate loose contact of hard surfaces. This can be achieved firstly by tightly fixing all such joints.
 - 1. For example, snug fitting ceiling tiles and retention clips should be used for the ceiling suspension system to eliminate rattling of the suspension grid in response to acoustical excitation.

- B. Particular attention is drawn to supply and return air grilles. Forward a sample of the proposed grilles for the Architect's approval.
- C. If it is considered impractical to eliminate movement of such construction elements then it is recommended that contact between hard surfaces should be eliminated by application of an acoustically resilient material between the otherwise touching, hard surfaces.
 - 1. Acoustically suitable resilient materials include neoprene sponge tape, acoustical sealant, acoustical foam and/or sound damping compound.
- D. In order to minimize acoustical excitation and noise radiation from large areas of metal, e.g. steel ducts, it is recommended that all such surfaces shall be acoustically damped.
 - 1. This may be achieved, where appropriate, by application of a closely fitting, resilient lagging material, such as mineral fiber.
 - 2. Alternatively, damping compounds are commercially available for this purpose.
 - 3. Follow manufacturer's instructions in application of these materials.
 - 4. In marginal cases, application of a thick layer of undercoat may provide sufficient acoustical damping to eliminate rattling.
- E. It is critical to pay attention to this rattle elimination requirement throughout the construction period. Certain sources of rattling (rattling metal studs inside partition cavities, for example) are extremely difficult to remedy close to project completion when cavities are no longer accessible.

3.02 FIELD QUALITY CONTROL

- A. Identify and correct sources of rattling in a timely manner by lightly exciting construction elements with a rubber mallet, or cloth wrapped hammer, and listening for rattles.
 - 1. Once this test is complete and is satisfied that all loose fittings have been addressed, contact the acoustical consultant to review the construction, subject to approval by the Architect.
 - 2. This process is required at the following times:
 - a. Prior to closing up the walls.
 - b. Prior to closing up the hard lid (where applicable).
 - c. Prior to installation of the finish ceiling.
- B. Notify the Architect and project inspector a minimum of one week prior to when the project site is ready for review.

END OF SECTION

SECTION 01 91 13 GENERAL COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section specifies the Contractor's responsibilities for commissioning:
 - 1. Comply with Section 5.410.2 Commissioning per the California Green Building Standards Code, California Energy Code, and California Administrative Code Section "10-103 Administrative Regulations for the California Energy Commission (CEC)."
 - a. California Administrative Code Section 10-103 requires Acceptance Testing on all newly installed lighting controls, mechanical systems, envelopes, and process equipment after installation and before project completion. An Acceptance Test is a functional performance test to help ensure that newly installed equipment is operating and in compliance with the Energy Code.
 - b. Lighting controls acceptance tests must be performed by a certified lighting controls Acceptance Test Technician (ATT).
 - c. Mechanical system acceptance tests must be performed by a certified mechanical ATT for projects submitted on or after October 1, 2021.
 - d. Envelope and process equipment acceptance tests shall be performed by the installing contractor, engineer/architect of record or the owner's agent.
 - e. A listing of certified ATT can be found at: <https://www.energy.ca.gov/programs-and-topics/programs/acceptance-test-technician-certification-provider-program/acceptance>.
 - f. The Acceptance Testing procedures must be repeated, and deficiencies must be corrected by the builder or installing contractor until the construction/installation of the specified systems conform and pass the required acceptance criteria.
 - g. Project inspectors will collect the forms to confirm that the required Acceptance Tests have been completed.
 - 2. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists executed by Contractor are utilized to achieve this.
 - 3. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests executed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 4. Verify that operation and maintenance manuals submitted to District are complete: Detailed operation and maintenance (O&M) data submittals by Contractor are utilized to achieve this.
 - 5. Verify that the District's operating personnel are adequately trained: Formal training conducted by Contractor is utilized to achieve this.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Functional Completion.
- C. The Commissioning Authority directs and coordinates all commissioning activities; this section describes some but not all of the Commissioning Authority's responsibilities.

D. The Commissioning Authority is employed by Construction Manager on behalf of District.

1.02 SCOPE OF COMMISSIONING

A. The following are to be commissioned:

1. Building envelope:
 - a. Thermal and moisture integrity.
 - b. Air tightness.
2. Fire Protection Systems.
3. Plumbing Systems:
 - a. Water heaters.
 - 1) Flow and temperature at handwashing and foodprep sinks.
 - b. Booster pumps.
 - c. Landscape irrigation.
4. HVAC System, including:
 - a. Major and minor equipment items.
 - b. Piping systems and equipment.
 - c. Ductwork and accessories.
 - d. Terminal units.
 - e. Control system.
 - f. Sound control devices.
 - g. Vibration control devices.
 - h. Variable frequency drives.
5. Special Ventilation:
 - a. Kitchen exhaust hoods.
 - b. Specialty fans.
6. Electrical Systems:
 - a. Power quality.
 - b. Emergency power systems.
 - c. Lighting controls other than manual switches.
7. Electronic Safety and Security:
 - a. Security system, including doors and hardware.
 - b. Fire and smoke alarms.
8. Communications:
 - a. Voice and data systems.
 - b. Public address/paging.
9. Other equipment and systems explicitly identified elsewhere in Contract Documents as requiring commissioning.
10. Indoor Air Quality Procedures: The Commissioning Authority will coordinate; Contractor will execute; see Section 01 57 19 - Temporary Environmental Controls.
11. Battery Energy Storage Systems: See Section 26 33 73.

1.03 RELATED REQUIREMENTS

- A. Section 01 57 19 - Temporary Environmental Controls: Precautions and procedures; smoking room testing; building flush-out.
- B. Section 01 70 00 - Execution and Closeout Requirements: General startup requirements.
- C. Section 01 78 00 - Closeout Submittals: Scope and procedures for operation and maintenance manuals and project record documents.
- D. Section 01 79 00 - Demonstration and Training: Scope and procedures for District personnel training.

1.04 REFERENCE STANDARDS

- A. CSI/CSC MF - Masterformat; 2016.
- B. PECI (Samples) - Sample Forms for Prefunctional Checklists and Functional Performance Tests; Current Edition.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures; except:
 - 1. Make all submittals specified in this section, and elsewhere where indicated for commissioning purposes, directly to the Commissioning Authority.
 - 2. Submit one copy to the Commissioning Authority, not to be returned.
 - 3. Make commissioning submittals on time schedule specified by Commissioning Authority.
 - 4. Submittals indicated as "Draft" are intended for the use of the Commissioning Authority in preparation of Prefunctional Checklists or Functional Test requirements; submit in editable electronic format, Microsoft Word 2010 preferred.
 - 5. As soon as possible after submittals made to Architect are approved, submit copy of approved submittal to the Commissioning Authority.
- B. Product Data: If submittals to Architect do not include the following, submit copies as soon as possible:
 - 1. Manufacturer's product data, cut sheets, and shop drawings.
 - 2. Manufacturer's installation instructions.
 - 3. Startup, operating, and troubleshooting procedures.
 - 4. Fan and pump curves.
 - 5. Factory test reports.
 - 6. Warranty information, including details of District's responsibilities in regard to keeping warranties in force.
- C. Manufacturers' Instructions: Submit copies of all manufacturer-provided instructions that are shipped with the equipment as soon as the equipment is delivered.
- D. Startup Plans and Reports.
- E. Completed Prefunctional Checklists.
- F. Commissioning Issues Log:
 - 1. Construction observations.
 - 2. Supporting photographs.

1.06 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

PART 2 PRODUCTS

2.01 TEST EQUIPMENT

- A. Provide all standard testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will NOT become the property of District.
- B. Provide all standard testing equipment required to perform building envelope air tightness testing; unless otherwise noted such testing equipment will NOT become the property of District.
- C. Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure system performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.
 - 2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
 - 3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- D. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to District; such equipment, tools, and instruments are to become the property of District.
- E. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.
 - 1. Dataloggers required to for Functional Tests will be provided by the Commissioning Authority and will not become the property of District.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Commissioning Authority will complete the Commissioning Plan.
 - 1. Attend meetings called by the Commissioning Authority for purposes of completing the commissioning plan.
 - 2. Require attendance and participation of relevant subcontractors, installers, suppliers, and manufacturer representatives.
- B. Contractor is responsible for compliance with the Commissioning Plan.
- C. Commissioning Plan: The commissioning schedule, procedures, and coordination requirements for all parties in the commissioning process.
 - 1. Commissioning will be phased (by floors, for example) to minimize the total construction time.

- D. Basis of Design Documentation (BOD): Detailed documentation of the functional requirements of the project; descriptions of the systems, components, and methods chosen to meet the design intent; assumptions underlying the design intent.
 - 1. Basis of Design Documentation is to be prepared by Design-Builder.
- E. Commissioning Schedule:
 - 1. Submit anticipated dates of startup of each item of equipment and system to Commissioning Authority within 60 days after award of Contract.
 - 2. Re-submit anticipated startup dates monthly, but not less than 4 weeks prior to startup.
 - 3. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 - 4. Provide sufficient notice to Commissioning Authority for delivery of relevant Checklists and Functional Test procedures, to avoid delay.

3.02 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 - 1. Startup Plan: SP-.
 - 2. Startup Report: SR-.
 - 3. Prefunctional Checklist: PC-.
 - 4. Functional Test Procedure: FTP-.
 - 5. Functional Test Report: FTR-.
- C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
 - 1. 2300: HVAC system as a whole.
 - 2. 2320: HVAC Piping and Pumps.
 - 3. 2330: HVAC Air Distribution.
- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

3.03 STARTUP PLANS AND REPORTS

- A. Startup Plans: For each item of equipment and system for which the manufacturer provides a startup plan, submit the plan not less than 8 weeks prior to startup.
- B. Startup Reports: For each item of equipment and system for which the manufacturer provides a startup checklist (or startup plan or field checkout sheet), document compliance by submitting the completed startup checklist prior to startup, signed and dated by responsible entity.
- C. Submit directly to the Commissioning Authority.

3.04 PREFUNCTIONAL CHECKLISTS

- A. A Prefunctional Checklist is required to be filled out for each item of equipment or other assembly specified to be commissioned.

1. No sampling of identical or near-identical items is allowed.
 2. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.
 3. Prefunctional Checklist forms will not be complete until after award of the contract; the following types of information will be gathered via the completed Checklist forms:
 - a. Certification by installing contractor that the unit is properly installed, started up, and operating and ready for Functional Testing.
 - b. Confirmation of receipt of each shop drawing and commissioning submittal specified, itemized by unit.
 - c. Manufacturer, model number, and relevant capacity information; list information "as specified," "as submitted," and "as installed."
 - d. Serial number of installed unit.
 - e. List of inspections to be conducted to document proper installation prior to startup and Functional Testing; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
 - f. Sensor and actuator calibration information.
 4. A preliminary list of Prefunctional Checklists is attached, to indicate anticipated scope.
 5. PECEI (Samples) found at <http://www.peci.org/library/mcpgs.htm> indicate anticipated level of detail for Prefunctional Checklists.
- B. Contractor is responsible for filling out Prefunctional Checklists, after completion of installation and before startup; witnessing by the Commissioning Authority is not required unless otherwise specified.
1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
 2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
 3. Individual Checklists may contain line items that are the responsibility of more than one installer; Contractor shall assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
 4. If any Checklist line item is not relevant, record reasons on the form.
 5. Contractor may independently perform startup inspections and/or tests, at Contractor's option.
 6. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
 7. Submit completed Checklists to Commissioning Authority within two days of completion.
 8. See Section 01 70 00 - Execution and Closeout Requirements for additional general startup requirements.
- C. Commissioning Authority is responsible for furnishing the Prefunctional Checklists to Contractor.
1. Initial Drafts: Contractor is responsible for initial draft of Prefunctional Checklist where so indicated in Contract Documents.

2. Provide all additional information requested by Commissioning Authority to aid in preparation of checklists, such as shop drawing submittals, manufacturers' startup checklists, and O&M data.
 3. Commissioning Authority may add any relevant items deemed necessary regardless of whether they are explicitly mentioned in Contract Documents or not.
 4. When asked to review the proposed Checklists, do so in a timely manner.
- D. Commissioning Authority Witnessing: Required for:
1. Each piece of primary equipment, unless sampling of multiple similar units is allowed by the commissioning plan.
 2. A sampling of non-primary equipment, as allowed by the commissioning plan.
- E. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to District.
1. If difficulty in correction would delay progress, report deficiency to the Commissioning Authority immediately.

3.05 FUNCTIONAL TESTS

- A. A Functional Test is required for each item of equipment, system, or other assembly specified to be commissioned, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
- B. Contractor is responsible for execution of required Functional Tests, after completion of Prefunctional Checklist and before closeout.
- C. Commissioning Authority is responsible for witnessing and reporting results of Functional Tests, including preparation and completion of forms for that purpose.
- D. Contractor is responsible for correction of deficiencies and re-testing at no extra cost to District; if a deficiency is not corrected and re-tested immediately, the Commissioning Authority will document the deficiency and the Contractor's stated intentions regarding correction.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
 2. Use the standard form provided with copies submitted to District and Contractor.
 3. When the deficiency has been corrected, the Contractor completes the form certifying that the item is ready to be re-tested and returns the form to the Commissioning Authority; the Commissioning Authority will reschedule the test and the Contractor shall re-test.
 4. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
 5. Contractor shall bear the cost of District and Commissioning Authority personnel time witnessing re-testing.
 6. Contractor shall bear the cost of District and Commissioning Authority personnel time witnessing re-testing if the test failed due to failure to execute the relevant Prefunctional Checklist correctly; if the test failed for reasons that would not have been identified in the Prefunctional Checklist process, Contractor shall bear the cost of the second and subsequent re-tests.
- E. Functional Test Procedures:

1. Some test procedures are included in Contract Documents; where Functional Test procedures are not included in Contract Documents, test procedures will be determined by the Commissioning Authority with input by and coordination with Contractor.
2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment and systems (rather than just components) using manual (direct observation) or monitoring methods under full operation (e.g., the chiller pump is tested interactively with the chiller functions to see if the pump ramps up and down to maintain the differential pressure setpoint).
 - b. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied, varying outside air temperatures, fire alarm, power failure, etc.
 - c. Systems are run through all the HVAC control system's sequences of operation and components are verified to be responding as the sequence's state.
 - d. Traditional air or water test and balancing (TAB) is not Functional Testing; spot checking of TAB by demonstration to the Commissioning Authority is Functional Testing.
3. A preliminary list of Functional Tests is attached, to indicate anticipated scope.
4. PECI (Samples) found at <http://www.peci.org/library/mcpgs.htm> indicated anticipated level of detail for Functional Tests.
- F. Deferred Functional Tests: Some tests may need to be performed later, after Final Inspection, due to partial occupancy, equipment, seasonal requirements, design or other site conditions; performance of these tests remains the Contractor's responsibility regardless of timing.
- G. Factory Tests: Commissioning Authority and Contractor are responsible for coordinating testing of equipment at the factory by factory personnel, to ensure compliance with commissioning requirements.
- H. Field Tests By Others: Where Functional Tests are indicated as to be performed by others not subject to Contract Documents, those tests are not subject to these commissioning requirements.

3.06 SENSOR AND ACTUATOR CALIBRATION

- A. Calibrate all field-installed temperature, relative humidity, carbon monoxide, carbon dioxide, and pressure sensors and gauges, and all actuators (dampers and valves) on this piece of equipment shall be calibrated. Sensors installed in the unit at the factory with calibration certification provided need not be field calibrated.
- B. Calibrate using the methods described below; alternate methods may be used, if approved by Commissioning Authority and Owner beforehand. See PART 2 for test instrument requirements. Record methods used on the relevant Prefunctional Checklist or other suitable forms, documenting initial, intermediate and final results.
- C. All Sensors:
 1. Verify that sensor location is appropriate and away from potential causes of erratic operation.
 2. Verify that sensors with shielded cable are grounded only at one end.
 3. For sensor pairs that are used to determine a temperature or pressure difference, for temperature make sure they are reading within 0.2 degree F of each other, and for pressure, within tolerance equal to 2 percent of the reading, of each other.
 4. Tolerances for critical applications may be tighter.

- D. Sensors Without Transmitters - Standard Application:
1. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 2. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 3. If not, install offset, calibrate or replace sensor.
- E. Sensors With Transmitters - Standard Application.
1. Disconnect sensor.
 2. Connect a signal generator in place of sensor.
 3. Connect ammeter in series between transmitter and building automation system control panel.
 4. Using manufacturer's resistance-temperature data, simulate minimum desired temperature.
 5. Adjust transmitter potentiometer zero until 4 mA is read by the ammeter.
 6. Repeat for the maximum temperature matching 20 mA to the potentiometer span or maximum and verify at the building automation system.
 7. Record all values and recalibrate controller as necessary to comply with specified control ramps, reset schedules, proportional relationship, reset relationship and P/I reaction.
 8. Reconnect sensor.
 9. Make a reading with a calibrated test instrument within 6 inches of the site sensor.
 10. Verify that the sensor reading, via the permanent thermostat, gauge or building automation system, is within the tolerances in the table below of the instrument-measured value.
 11. If not, replace sensor and repeat.
 12. For pressure sensors, perform a similar process with a suitable signal generator.
- F. Sensor Tolerances for Standard Applications: Plus/minus the following maximums:
1. Watthour, Voltage, Amperage: 1 percent of design.
 2. Pressure, Air, Water, Gas: 3 percent of design.
 3. Air Temperatures (Outside Air, Space Air, Duct Air): 0.4 degrees F.
 4. Relative Humidity: 4 percent of design.
 5. Barometric Pressure: 0.1 inch of Hg.
 6. Flow Rate, Air: 10 percent of design.
 7. Flow Rate, Water: 4 percent of design.
 8. AHU Wet Bulb and Dew Point: 2.0 degrees F.
 9. Hot Water Coil and Boiler Water Temperature: 1.5 degrees F.
 10. Cooling Coil, Chilled and Condenser Water Temperatures: 0.4 degrees F.
 11. Combustion Flue Temperature: 5.0 degrees F.
 12. Oxygen and CO₂ Monitors: 0.1 percentage points.
 13. CO Monitor: 0.01 percentage points.
 14. Natural Gas and Oil Flow Rate: 1 percent of design.
- G. Critical Applications: For some applications more rigorous calibration techniques may be required for selected sensors. Describe any such methods used on an attached sheet.
- H. Valve/Damper Stroke Setup and Check:

1. For all valve/damper actuator positions checked, verify the actual position against the control system readout.
 2. Set pump/fan to normal operating mode.
 3. Command valve/damper closed; visually verify that valve/damper is closed and adjust output zero signal as required.
 4. Command valve/damper to open; verify position is full open and adjust output signal as required.
 5. Command valve/damper to a few intermediate positions.
 6. If actual valve/damper position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).
- I. Isolation Valve or System Valve Leak Check: For valves not associated with coils.
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.

3.07 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 2. Sampling is not allowed for:
 - a. Major equipment.
 - b. Life-safety-critical equipment.
 - c. Prefunctional Checklist execution.
 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
 7. If YY percent of the units in the second sample fail, test all remaining identical units.
 8. If frequent failures occur, resulting in more troubleshooting than testing, the Commissioning Authority may stop the testing and require Contractor to perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").

- E. Simulating Conditions: Artificially create the necessary condition for the purpose of testing the response of a system; for example apply hot air to a space sensor using a hair dryer to see the response in a VAV box.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the outside air temperature value from 50 degrees F to 75 degrees F to verify economizer operation.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a damper to be 100 percent closed, are considered indirect indicators.
- I. Monitoring: Record parameters (flow, current, status, pressure, etc.) of equipment operation using dataloggers or the trending capabilities of the relevant control systems; where monitoring of specific points is called for in Functional Test Procedures:
 - 1. All points that are monitored by the relevant control system shall be trended by Contractor; at the Commissioning Authority's request, Contractor shall trend up to 20 percent more points than specified at no extra charge.
 - 2. Other points will be monitored by the Commissioning Authority using dataloggers.
 - 3. At the option of the Commissioning Authority, some control system monitoring may be replaced with datalogger monitoring.
 - 4. Provide hard copies of monitored data in columnar format with time down left column and at least 5 columns of point values on same page.
 - 5. Graphical output is desirable and is required for all output if the system can produce it.
 - 6. Monitoring may be used to augment manual testing.

3.08 OPERATION AND MAINTENANCE MANUALS

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.
- B. Add design intent documentation furnished by Architect to manuals prior to submission to District.
- C. Submit manuals related to items that were commissioned to Commissioning Authority for review; make changes recommended by Commissioning Authority.
- D. Commissioning Authority will add commissioning records to manuals after submission to District.

END OF SECTION

SECTION 01 91 14 COMMISSIONING AUTHORITY RESPONSIBILITIES

PART 1 GENERAL

1.01 SUMMARY

- A. Commissioning is intended to achieve the following specific objectives; this section covers the Commissioning Authority's responsibilities for commissioning:
 - 1. Verify that the work is installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup: Startup reports and Prefunctional Checklists are utilized to achieve this.
 - 2. Verify and document that functional performance is in accordance with Contract Documents: Functional Tests performed by Contractor and witnessed by the Commissioning Authority are utilized to achieve this.
 - 3. Verify that operation and maintenance manuals submitted to District are complete: Detailed O&M data submittals are specified.
 - 4. Verify that the District's operating personnel are adequately trained: Formal training conducted by Contractor is specified.
- B. Commissioning, including Functional Tests, O&M documentation review, and training, is to occur after startup and initial checkout and be completed before Final Inspection.
- C. Coordinate and direct all the commissioning activities in a logical, sequential and efficient manner using consistent protocols and forms, centralized documentation, clear and regular communications and consultations with all necessary parties, frequently updated timelines and schedules and technical expertise.
- D. The Commissioning Authority is employed by Construction Manager on behalf of District.
- E. The scope of commissioning activities is defined in Section 01 91 13 - General Commissioning Requirements.
- F. Contractor's responsibilities are defined in Section 01 91 13 - General Commissioning Requirements.

1.02 DEFINITIONS

- A. Acceptance Criteria: Threshold of acceptable work quality or performance specified for a commissioning activity, including, but not limited to, construction checklists, performance tests, performance test demonstrations, commissioning tests and commissioning test demonstrations.
- B. Basis of Design: A document that records the concepts, calculations, decisions, and product selections used to meet District's project requirements and to satisfy applicable regulatory requirements, standards, and guidelines. The document includes both narrative descriptions and lists of individual items that support the design process.
- C. Commissioning Authority (CxA): A qualified and certified firm or individual responsible for delivery of the commissioning process.
 - 1. When applicable to a firm, indicates a entity certified through one or more of the organizations listed in the Quality Assurance article.

2. When applicable to an individual, equivalent terms with same meaning used in this Section include: Building Commissioning Professional (BCxP); Commissioning Professional (CxP); Commissioning Process Professional (CxPP).
- D. Commissioning Process: Quality-oriented process for achieving, verifying, and documenting that the performance of facilities, systems, and assemblies meets defined objectives and criteria.
- E. Deferred Tests: Tests performed after Date of Final Inspection, with District's approval, due to seasonal requirements, site conditions, or both, that prohibit the tests from being performed prior to achieving Final Inspection.
- F. Deficiency: Condition of a component, piece of equipment, or system that is not in compliance with the Contract Documents.
- G. Integrated System Test: Test of multiple systems that are designed to dynamically function and operate in coordinated and properly sequenced fashion. Tests are intended to be conducted under various modes and through every specified sequence of operations.
- H. District's Project Requirements (OPR): A written document that details the District's functional requirements of a project and the expectations of how it will be used and operated. It includes project goals, measurable performance criteria, cost considerations, applicable benchmarks, reference standards, success criteria, and supporting information.

1.03 REFERENCE STANDARDS

- A. ASHRAE Guideline 1.1 - HVAC&R Technical Requirements for the Commissioning Process; 2007, with Errata (2012).
- B. ASHRAE Std 202 - The Commissioning Process Requirements for New Buildings and New Systems; 2024.
- C. ASTM E779 - Standard Test Method for Determining Air Leakage Rate by Fan Pressurization; 2019.
- D. CSI/CSC MF - Masterformat; 2016.
- E. NECA 90 - Standard for Commissioning Building Electrical Systems; 2015.
- F. NFPA 3 - Standard for Commissioning of Fire Protection and Life Safety Systems; 2024.

1.04 SUBMITTALS

- A. Commissioning Plan:
 1. Submit preliminary draft for review by District and Architect within 30 days after commencement of Commissioning Authority contract.
 2. Submit revised draft to be included in the construction Contract Documents, not less than 4 weeks prior to bid date.
 3. Submit final plan not more than 90 days after commencement of construction, for issuance to all parties.
- B. List of Prefunctional Checklists to be developed:
 1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
 3. Submit final list not more than 60 days after start of construction.
- C. Prefunctional Checklists:

1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit revised draft for review by District and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- D. List of Functional Test procedures to be developed:
1. Submit preliminary list at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit revised list not less than 6 weeks prior to bid date, for inclusion in Contract Documents; this is intended to be a list of titles, not full description of the tests.
 3. Submit final list not more than 60 days after start of construction.
- E. Functional Test Procedures:
1. Submit preliminary draft at start of construction documents phase or within 30 days after commencement of contract, whichever is later.
 2. Submit revised draft for review by District and Architect not less than 6 weeks prior to bid date, for inclusion in the construction Contract Documents.
 3. Submit final draft to Contractor not less than 4 weeks prior to startup of particular items to be commissioned.
- F. Training Plan.
- G. Recommissioning Manual: Submit within 60 days after receipt of District's instructions to proceed with preparation.
- H. Commissioning Process Record: Submit to Contractor for inclusion with O&M manuals. Include, at a minimum the following:
1. Issues Log
 2. Construction Checklists
 3. CxA Site Visit and Cx Team Meeting Minutes
 4. O & M Review
 5. Training Documentation
 6. Warranty Review
 7. Test Data Reports
 8. Summary Report
- I. Final Commissioning Report: Submit to District. Include the following:
1. A statement that systems have been completed in accordance with Contract Documents, and that the systems are performing in accordance with the final District's project requirements document.
 2. Identification and discussion of any substitutions, compromises, or variances between the final design intent, Contract Documents and as-built conditions.
 3. Description of components and systems that exceed District's project requirements and those which do not meet the requirements and why.
 4. Summary of issues, both resolved and unresolved, and any recommendations for resolution of remaining items.

5. A list of post-construction activities and results including deferred & seasonal testing results, test data reports and additional training documentation.
 6. A narrative of lessons learned for future commissioning project efforts
- J. Commissioning Firm's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Commissioning Process: Conduct the commissioning process using ASHRAE Std 202 as the reference for applying the whole-building principles to facility elements.
- B. Commissioning Firm Qualifications: Firm experienced in commissioning assemblies and systems specified to be included in scope of work of this Section, and certified by one or more of the following organizations.
1. AABC Commissioning Group (ACG), for commissioning of HVAC Systems and Special Ventilation Systems.
 - a. Commissioning Team Leader: AABC Certified Commissioning Authority (CxA). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
 - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of CxA.
 2. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) for commissioning of HVAC Systems
 - a. Commissioning Team Leader: ASHRAE Certified Building Commissioning Professional (BCxP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
 - b. Commissioning Team Members: Technicians employed by commissioning firm and working under direct supervision of BCxP.
 3. Association of Energy Engineers (AEE) for commissioning of HVAC Systems
 - a. Commissioning Team Leader: AEE Certified Building Commissioning Professional (BCxP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
 - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of BCxP.
 4. Building Commissioning Association (BCA) for commissioning of HVAC Systems
 - a. Commissioning Team Leader: BCA Certified Commissioning Professional (CxP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
 - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of CxP.
 5. National Environmental Balancing Bureau (NEBB) for commissioning of HVAC Systems
 - a. Commissioning Team Leader: NEBB Certified Commissioning Process Professional (CxPP). An individual with technical and management experience who leads a qualified team that plans and coordinates the commissioning process.
 - b. Commissioning Team Members: Certified Commissioning Technicians (CxT) employed by commissioning firm and working under direct supervision of CxA.
- C. Commissioning Plan: Prepare a plan that provides direction for commissioning tasks during construction phase of the project. Include, at a minimum, the following content at the level of detail appropriate to project scope and complexity:

1. General project information.
2. List of team members.
3. Team members' roles and responsibilities
4. Description of the goals of the plan.
5. Abbreviations and definitions used in the document.
6. Scope of commissioning activities.
7. Proposed overall schedule, tied to project construction schedule.
8. General management plan.
9. Description of the commissioning process, including documents to be used for facilitating:
 - a. Prefunctional checking and readiness verification.
 - b. Start-up plan and procedures.
 - c. Functional test plan and verification procedures.
 - d. Retesting procedures.
 - e. Management protocols for address deficiencies due to defective products or non-complying work.
 - f. Management protocols for addressing other project-specific issues.
10. Phased commissioning activities, planned and unplanned.
11. Warranty period seasonal and deferred testing.
12. Progress reporting and log for tracking issues.
13. Training and orientation of District's personnel above and beyond.
14. Commissioning record table of contents.

PART 2 PRODUCTS

2.01 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 1. Commissioning Plan: CP-.
 2. Prefunctional Checklist: PC-.
 3. Functional Test Procedure: FTP-.
 4. Functional Test Report: FTR-.
 5. Commissioning Report: CR-.
- C. System Type: Use the first 4 digits from CSI/CSC MF (Master Format), that are applicable to the system; for example:
 1. 2300: HVAC system as a whole.
 2. 2320: HVAC Piping and Pumps.
 3. 2330: HVAC Air Distribution.
- D. Component Number: Assign numbers sequentially, using 1, 2, or 3 digits as required to accommodate the number of units in the system.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.

- F. Example: PC-2320-001.2 would be the Prefunctional Checklist for equipment item 1 in the HVAC piping system, probably a pump; this is the second, revised submittal of this checklist.

PART 3 EXECUTION

3.01 COMMISSIONING PLAN

- A. Prepare and implement the Commissioning Plan, covering commissioning schedule, Prefunctional Checklist and Functional Test procedures, coordination requirements, and forms to be used, for all parties in the commissioning process.
1. Call and chair meetings of the Commissioning team when appropriate.
 2. Give Contractor sufficient notice for scheduling commissioning activities.
 3. Develop a comprehensive start-up and initial systems checkout plan with cooperation of Contractor and subcontractors.
 4. Commissioning will be phased (by floors, for example) to minimize the total construction time.
 5. ASHRAE Guideline 1.1 may be used as a guide for the Commissioning Plan.
 6. Avoid replication of information included in the construction Contract Documents to the greatest extent possible.
- B. Owner's Project Requirements: As defined above.
1. Prepared By: District.
 2. Copy to be furnished to Commissioning Authority for use in preparation of the commissioning plan.
- C. Basis of Design Documentation: As defined above.
1. Prepared By: Architect.
 2. Copy to be furnished to Commissioning Authority for use in preparation of the commissioning plan.
- D. Review the construction Contract Documents for Contractor submittals of draft checklists, draft test procedures, manufacturer startup procedures, and other information intended for the use of the Commissioning Authority in preparing the Commissioning Plan.
- E. Commissioning Schedule:
1. Coordinate with Contractor anticipated dates of startup of each item of equipment and system.
 2. Contractor's scheduling responsibilities are specified in the construction Contract Documents.
 3. Revise and re-issue schedule monthly.
 4. Prefunctional Checklists and Functional Tests are to be performed in sequence from components, to subsystems, to systems.
 5. Deliver relevant Prefunctional Checklists and Functional Test Procedures to Contractor in time to avoid delay.
- F. Commissioning Team: Project manager or other designated person of:
1. District's building or plant operation staff.
 2. Commissioning Authority.
 3. Construction Manager.
 4. Design professional's design team.

5. General Contractor.
6. Fire Protection subcontractor.
7. Plumbing subcontractor.
8. HVAC subcontractor.
9. HVAC control system subcontractor.
10. HVAC testing, adjusting, and balancing (TAB) subcontractor.
11. Electrical subcontractor.
12. Communications subcontractor.
13. Other subcontractors who will be required to perform commissioning activities.

3.02 CONSTRUCTION CONTRACT DOCUMENTS

- A. Review the OPR and BOD documents, and project design for commissioning provisions.
- B. General Commissioning Specifications: Architect has prepared general commissioning specifications for inclusion in the construction Contract Documents; review and submit comments to District.
 1. These specifications include:
 - a. Procedures applicable to all types of items to be commissioned.
 - b. General commissioning procedures for thermal and moisture protection.
 - c. General commissioning procedures for openings and fenestration systems.
 - d. General commissioning procedures for fire protection.
 - e. General commissioning procedures for plumbing.
 - f. General commissioning procedures for HVAC.
 - g. General commissioning procedures for integrated automation.
 - h. General commissioning procedures for electrical.
 - i. General commissioning procedures for communications.
 2. Prepare specifications for any of the following that would be recommended, for incorporation into the construction Contract Documents by Architect:
 - a. Additional Contractor submittals needed for purposes of commissioning, such as startup procedures, draft test procedures, draft training plans, etc.
 - b. Additional District personnel training.
 - c. Additional operation or maintenance data that should be submitted.
- C. Prefunctional Checklists: Develop detailed Checklists for each item to be commissioned.
 1. List of Checklists to be Developed: Prepare and maintain a detailed list of titles, not full text.
 2. The Checklist forms are intended to be part of the Contractor's Contract Documents.
- D. Functional Testing: Develop detailed procedures for each item to be commissioned; submit for review by District and Architect.
 1. List of Test Procedures to be Developed: Prepare and maintain a detailed list of titles, not full text.

2. The forms the Commissioning Authority will use to report Functional Test results are not intended to be part of Contractor's Contract Documents, but the Functional Test Procedures that must be executed by the Contractor must be made part of the Contract Documents, by modification if necessary.
 3. Architect is required to prepare outlines of Functional Testing for major equipment and systems.
- E. Develop any other reporting forms Contractor will be required to use; if they are likely to require a substantially different amount of work than the Contractor can reasonably anticipate, they must be included in the construction Contract Documents.
- F. If any part of the documents described above have not been developed by the bid date, coordinate with Architect the issuance of modifications to the construction Contract Documents

3.03 PREFUNCTIONAL CHECKLISTS

- A. Prefunctional Checklists - Content: Prepare forms for Contractor's use, in sufficient detail to document that the work has been installed in accordance with Contract Documents and the manufacturer's recommendations and instructions, and that it receives adequate operational checkout prior to startup.
1. Prepare separate Checklists for each type of equipment, system, or other assembly, customized to the item.
 2. Identify each Checklist by using Contract Documents identification number or name, if any; if none, create unique identifiers for each Checklist; do not rely on Contractor to number checklists.
 3. Multiple identical or near-identical items may appear on a single Checklist provided there is space to record all required data for each separately; label each set of data uniquely.
 4. Include space to record manufacturer name, model number, serial number, capacity and other relevant characteristics, and accessories and other features as applicable; include space to record "as specified", "as submitted", and "as installed" data.
 5. Include space to record whether or not the required submittals have been received; list each separate type of submittal.
 6. Include line items for each physical inspection to be performed.
 7. Include line items for each operational inspection to be performed, such as checking switch operation, fan rotation, valve and damper stroke, and measuring actual electrical loads.
 8. Include separate section for sensors and actuators, with space for documenting actual physical location and calibration measurements; provide a separate generic calibration checklist identified wherever referenced.
 9. Include spaces to record that related Checklists for related work upon which this work depends have been completed.
- B. Prefunctional Checklists - Format:
1. Provide a cover sheet showing name of equipment item or system, documentation identification number (see Documentation Identification Scheme), names of accessory components involved, and identification of related checklists.
 2. Include on cover sheet space for Contractor's use in attesting to completeness; provide spaces for the signatures of the general contractor and each subcontractor or other entity responsible, customized to the project and the type of item.

3. Include on the cover sheet, above the signature block, the following statement: "The work referenced in this Checklist and other work integral to or dependent on this work is complete and ready for functional testing. The checklist items are complete and have been checked off only by parties having direct knowledge of the event." Include two checkboxes:
 - a. "This Checklist is submitted for approval with no exceptions."
 - b. "This Checklist is submitted for approval, subject to the attached list of outstanding items, none of which preclude the performance of safe and reliable functional tests. A statement of completion will be submitted upon completion of the outstanding items."
4. Use a consistent, tabular format for all Checklists, with one line per checklist activity.
5. For each line item, provide space for initials and date, and identification of the subcontractor or other entity responsible.

3.04 FUNCTIONAL TEST PROCEDURES

- A. Develop test procedures in sufficient detail to demonstrate that functional performance is in accordance with Contract Documents, including proper operation through specified modes of operation where there is a different system response, including seasonal, unoccupied, warm-up, cool-down, part- and full-load regimes.
 1. Obtain assistance and review by installing subcontractors.
 2. Itemize each test sequence in step-by-step order, with acceptance criteria for each step and for the test as a whole.
 3. Include test setup instructions, description of tools and apparatus, special cautions, and.
 4. Avoid procedures that would void or otherwise limit warranties; review with Contractor prior to execution.
 5. For HVAC systems, procedures may include energy management control system trending, stand-alone datalogger monitoring, or manual functional testing.
 6. Submit to Construction Manager for review, and for approval if required.
 7. Obtain explicit approval of Contractor in regard to feasibility and safety prior to execution.
- B. Functional Test Forms: Prepare and distribute forms in advance of testing. Use a consistent format to the greatest degree practicable. For each form, include the following:
 1. General and specific instructions for using form.
 2. Document Identifiers:
 - a. Form Identifier (see Documentation Identification Scheme).
 - b. Date and Test Party Identifier: Identification of the date(s) of the test, and the party conducting it.
 3. Checklist of activities required of the Contractor prior to, during, and after the testing.
 4. Complete testing procedure information.
 - a. Instrumentation: A listing of instrumentation and tools necessary to complete the test.
 - b. Test Instructions: Step-by-step instructions of how to complete the test, including functionality to test, and conditions under which the tests should be performed. Include instructions for returning affected systems and equipment to their as-found state at the conclusion of the tests.
 - c. Formulas to be used in calculations.

- d. Acceptance Criteria: Measurable pass/fail criteria for each step of the test, as applicable.
 - 1) Referenced Criteria: Identify the source for required performance criteria.
- 5. Test Data:
 - a. Results: Include side-by-side fillable fields for recording the expected system response and the actual response. Note observed readings, results, and adjustments.
 - b. Deficiencies: Include fillable fields for a list of any discovered deficiencies and for an explanation of how they were mitigated.
- 6. "Yes/No" checkboxes to for documenting status of completion of required testing prerequisites and procedures.
 - a. Functional Test Prerequisites Checkboxes: Include for applicable items:
 - 1) Related equipment has been started up, and start-up reports and Prefunctional Checklists have been submitted and approved, and are ready for Functional Testing.
 - 2) Control system functions for this and any interlocking systems have been programmed and are operable in accordance with Contract Documents, including final set points and schedules with debugging, loop tuning, and sensor calibrations completed.
 - (a) Include signature of controls installer.
 - 3) Incomplete items identified by Architect during closeout inspections have been corrected or completed.
 - 4) Vibration control report has been approved (if required).
 - b. Functional Test Checkboxes: Include for applicable items:
 - 1) Procedures have been reviewed and approved by the affected installer.
 - 2) Safeties and operating ranges have been reviewed.
 - 3) False loading equipment, system and procedures are ready.
 - 4) Sufficient clearance around equipment for servicing has been provided.
 - 5) Original values of pre-test setpoints that need to be changed to accommodate testing have been recorded, .
 - (a) Provide a check document completion of return to original values (include control parameters, limits, delays, lockouts, schedules, etc.)
- 7. List of Attachments.
 - a. A copy of the specified sequence of operation.
 - b. A copy of applicable schedules and setpoints.
 - c. A copy of the specified Functional Test Procedures is attached.
 - 1) Any other items on the Prefunctional Checklist or Start-up Reports that need to be re-verified.
- 8. Signature Block: Signature of the designated commissioning lead and the system and equipment installer attesting that the recorded test results are accurate.
- C. Functional Performance Testing Reports: Use completed forms specified above, supplemented with additional information or explanations.
 - 1. Precautions Taken: Identify and describe actual precautions taken and how they mitigated potential risks inherent in testing procedures.

2. Instrumentation Used: If necessary, amend the original list to report the actual instrumentation and tools used.
3. Description of Test Procedures: If necessary, amend in appropriate detail the original sequence of steps to report actual steps taken to complete each functional performance test and the conditions under which the tests were performed.
4. Deficiencies: List any discovered deficiencies and how they were mitigated.

3.05 CONSTRUCTION PHASE

- A. Coordinate the commissioning work with Contractor and Construction Manager; ensure that commissioning activities are being incorporated into the master schedule.
- B. Perform site visits, as necessary, to observe component and system installations. Attend planning and job-site meetings to obtain information on construction progress. Review Contractor's meeting minutes for issues relating to the commissioning process. Assist in resolving discrepancies.
- C. Commissioning Kick-Off Meeting: Plan and conduct a meeting early in the construction phase to review proposed commissioning schedule, activities, and responsibilities with parties involved. Require attendance by every member of the Commissioning Team.
- D. Conduct periodic meetings as necessary to coordinate, resolve planning issues, and aid in resolution of deficiencies, minimizing the time spent by Contractor and District personnel; hold meetings at least monthly.
- E. Submit periodic progress reports to District and Contractor.
- F. Review Contractor shop drawing submittals applicable to systems being commissioned for compliance with commissioning needs; verify that District's responsibilities are clearly defined in warranties.
- G. Review and approve submittals directly related to commissioning.
- H. Deliver Prefunctional Checklists and Functional Test procedures to Contractor.
- I. Verify satisfactory completion of Prefunctional Checklists by Contractor by reviewing checklists and by site observation and spot checking; provide formal approval when satisfactory.
- J. Verify startup of all systems by reviewing start-up reports and by site observation; provide formal approval when satisfactory.
- K. Coordinate, witness and approve Functional Tests performed by Contractor. Coordinate retesting until satisfactory performance is achieved.
- L. Building Envelope Commissioning:
 1. Develop for Contractor's and Subcontractors' use project-specific checklists, each targeted for commissioning the installation of a set of related components and systems that comprise the building enclosure.
 2. Review the Contractor's and Subcontractors' project-specific performance implementation plans for building enclosure, including but not limited to the implementation and use of quality control/ quality assurance processes such as:
 - a. Proposed date ranges for conducting pressure and thermographic tests.
 - b. Daily field inspections.
 - c. Work progress documentation.
 - d. Weekly audits.
 - e. Use of installation checklists for each crew.

3. Conduct construction observation of building enclosure systems, at initial installation of work, milestone observations throughout construction, performance testing and verification of components and systems, their interfaces, and whole building performance test (if required).
4. Weather Conditions Suitable for Building Envelope Testing:
 - a. Winds and Temperature: As the test date approaches, monitor the weather forecast for the test site. Avoid testing on days forecast to experience high winds, rain, or snow. Monitor weather forecasts prior to shipping pressure test equipment to the site. Preferred ambient weather test conditions as stated in ASTM E779 are 0 to 4 miles per hour winds and an ambient temperature range of 41 to 95 degrees F. Based on current and forecast weather conditions, coordinate scheduling for the test to occur.
 - b. Rain: Do not test during rain or if rain is anticipated during testing.
 - 1) If pneumatic hoses have been installed and exposed to rain prior to testing, ensure rainwater has not migrated into the hose ends.
 - 2) Orient all exposed pneumatic hose ends to keep them out of water puddles.
 - c. Snow: Remove snow from around and on top of the building prior to testing.
- M. Fire Protection Systems Commissioning:
 1. Comply with requirements of NFPA 3.
- N. Plumbing Systems Commissioning:
 1. Comply with requirements stated in applicable Division 22 sections.
- O. HVAC Commissioning:
 1. Gather and review the control sequences and interlocks and work with Contractor and design engineers until sufficient clarity has been obtained, in writing, to be able to prepare detailed Functional Test procedures.
 2. Witness all or part of HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 3. Witness all or part of duct testing and cleaning procedures, sufficient to be confident that proper procedures were followed; document testing and include documentation in O&M manuals.
 4. Review TAB Plan prepared by Contractor.
 5. Before TAB is executed, witness sufficient Functional Testing of the control system to approve it to be used for TAB.
 6. Verify air and water systems balancing by spot testing, by reviewing completed reports, and by site observation; provide formal approval when satisfactory.
 7. Analyze trend logs and monitoring data to verify performance.
 8. Prepare a standard trend logging package of primary parameters that will provide District's operations staff clear indications of system function in order to identify proper system operation and trouble shoot problems; provide any additional information needed to interpret the trend logs.
- P. Special Ventilation Systems Commissioning:
 1. Comply with requirements of applicable Division 23 sections.
- Q. Integrated Automation Systems Commissioning:
 1. Comply with requirements of applicable Division 23 sections.

- R. Electrical Systems Commissioning:
 - 1. Comply with requirements of NECA 90.
- S. Witness and document testing of systems and components over which the Commissioning Authority does not have direct control, such as smoke control systems, tests contracted directly by District, and tests by manufacturer's personnel; include documentation in O&M manuals.
- T. When Functional Testing for specific systems or equipment is specified to be performed by the Commissioning Authority rather than the Contractor, perform such testing without assistance of Contractor.
- U. Maintain a master deficiency and resolution log and a separate testing record. Provide written progress and test reports with recommended actions.
- V. Operation and Maintenance Data: Review submitted operation and maintenance data for completeness; provide formal approval if satisfactory.
- W. Notify Contractor and District of deficiencies in procedures or results; suggest solutions.

3.06 TRAINING

- A. Training Plan: Prepare a comprehensive Training Plan, incorporating draft training plans submitted by Contractor.
 - 1. Include a 4 hour session by the HVAC design engineer covering the overall HVAC system and equipment design concepts, with one-line schematic drawings.
 - 2. Include a 4 hour session by the Commissioning Authority on the use of the blank Prefunctional Checklists and Functional Test forms for re-commissioning purposes.
 - 3. Establish criteria for determining satisfactory completion of training.
- B. Verify that training was satisfactorily completed; provide formal approval if satisfactory.
- C. Contractor will perform video recording of training sessions.

3.07 CLOSEOUT

- A. Commissioning Record: Use the same format and organization as specified for the O&M manuals.
 - 1. Include the Final Commissioning Plan and Final Report.
 - 2. For each product or system and equipment item, include the following organized as indicated, with separator tabs:
 - a. Design intent documentation, furnished by Architect or others.
 - b. Detailed operational sequences.
 - c. Startup plan and approved startup reports.
 - d. Filled out Prefunctional Checklists.
 - e. Filled out Functional Test reports; trend logs and monitoring reports and analysis; other verification documentation.
 - f. Training plan and training records.
 - g. Recommissioning recommendations, including time schedule and procedures; include blank copies of all Prefunctional Checklists and Functional Test report forms.
- B. Final Commissioning Report: Include:
 - 1. Executive summary.
 - 2. List of participants and roles.
 - 3. Brief facility description.

4. Overview of commissioning scope and general description of testing and verification methods.
 5. For each item commissioned, an evaluation of adequacy of:
 - a. The product itself; i.e. compliance with Contract Documents.
 - b. Installation.
 - c. Functional performance; include a brief description of the verification method used and observations and conclusions from the testing.
 - d. O&M documentation, including design intent.
 - e. Operator training.
 6. List of all outstanding non-compliance items, referenced to the specific functional test, inspection, trend log, etc., where the deficiency is documented.
 7. List of unresolved issues, seasonal or deferred testing, and other concerns that could affect facility operation.
 8. Recommendations for improvement to equipment or operations, future actions, commissioning process changes, etc. (about four to six pages).
 9. Attach appendices containing all commissioning documentation, including logs, minutes, reports, deficiency lists, communications, findings, etc., except that specified to be part of the Commissioning Record.
 - a. Include updated Owner's Project Requirements and Basis of Design documents
- C. Recommissioning Manual: Revise the Commissioning Plan documents, checklists, and Functional Test forms as necessary based on accepted recommendations of the final Commissioning Report. Provide step-by-step instructions for recommissioning, blank forms, and cross-references to O&M data needed during recommissioning.

3.08 POST-OCCUPANCY PHASE

- A. Assist in the development of a preventative maintenance plan, a detailed operating plan or an energy and resource management plan or as-built documentation.
- B. Coordinate deferred and seasonal Functional Tests; verify correction of deficiencies.
- C. On-Site Review: 10 months after Final Inspection conduct on-site review with District's staff.
 1. Review the current facility operation and condition of outstanding issues related to the original and seasonal commissioning.
 2. Interview staff to identify problems or concerns they have operating the facility as originally intended.
 3. Make suggestions for improvements and for recording these changes in the O&M manuals.
 4. Identify areas of concern that are still under warranty or are the responsibility of the original construction contractor.
 5. Assist facility staff in developing reports, documents and requests for services to remedy outstanding problems.

END OF SECTION

SECTION 02 41 00 DEMOLITION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
 - 1. Hazardous materials are covered by separate documents prepared by others.
- B. Selective demolition of built site elements.
 - 1. Demolition and removal of existing site improvements within Project area, as indicated on Drawings and as necessary to accomplish the Work, including:
 - a. Asphaltic concrete and portland cement concrete paving.
 - b. Abandoned underground utility lines outside of utility easement.
 - c. Pavement cutting and removal.
 - d. Debris removal.
 - 2. Handling and disposal of removed materials.
 - 3. Dewatering of excavations as necessary to control surface and sub-surface water.
- C. Abandonment and removal of existing utilities and utility structures.

1.02 RELATED REQUIREMENTS

- A. Section 00 31 00 - Available Project Information: Existing building survey conducted by District; information about known hazardous materials.
- B. Section 01 10 00 - Summary: Limitations on Contractor's use of site and premises.
- C. Section 01 10 00 - Summary: Description of items to be removed by District.
- D. Section 01 10 00 - Summary: Description of items to be salvaged or removed for re-use by Contractor.
- E. Section 01 50 00 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.
- F. Section 01 57 13 - Temporary Erosion and Sediment Control (SWPP).
- G. Section 01 60 00 - Product Requirements: Handling and storage of items removed for salvage and relocation.
- H. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- I. Section 01 74 19 - Construction Waste Management and Disposal: Limitations on disposal of removed materials; requirements for recycling.
- J. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal; earth stripping and stockpiling.
- K. Section 31 22 00 - Grading: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- L. Section 31 23 23 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.
- M. Section 32 93 00 - Planting: Relocation of existing trees, shrubs, and other plants.

- N. Section 32 93 00 - Planting: Pruning of existing trees to remain.

1.03 DEFINITIONS

- A. Class III Landfill: A landfill that accepts non-hazardous materials such as household, commercial, and industrial waste, resulting from construction, remodeling, repair, and demolition operations. A Class III landfill must have a solid waste facilities permit from the State of California.
- B. Demolition: Dismantle, raze, destroy or wreck any building or structure or any part thereof.
1. Demolition Waste: Building materials and solid waste resulting from construction, remodeling, repair, cleanup, or demolition operations that are not hazardous. This term includes, but is not limited to, asphalt concrete, Portland cement concrete, brick, lumber, gypsum wallboard, cardboard and other associated packaging, roofing material, ceramic tile, carpeting, plastic pipe, and steel. The materials may include rock, soil, tree stumps, and other vegetative matter resulting from land clearing and landscaping for construction or land development projects.
- C. Environmental Pollution and Damage: The presence of chemical, physical, or biological elements or agents which adversely affect human health or welfare; unfavorably alter ecological balances of importance to human or animal life; affect other species of importance to humanity; or degrade the utility of the environment for aesthetic, cultural or historical purposes.
- D. Inert Fill: A permitted facility that accepts inert waste such as asphalt and concrete exclusively for the purpose of disposal.
1. Inert Solids/Inert Waste: Non-liquid solid waste including, but not limited to, soil and concrete, that does not contain hazardous substances or soluble pollutants at concentrations in excess of water-quality standards established by a regional water board and does not contain significant quantities of decomposable solid waste.
- E. Recycling: The process of sorting, cleansing, treating and reconstituting materials for the purpose of using the altered form in the manufacture of a new product. Recycling does not include burning, incinerating or thermally destroying solid waste.
- F. Remove: Detach or dismantle items from existing construction and dispose of them off site, unless items are indicated to be salvaged or reinstalled.
- G. Remove and Salvage: Detach or dismantle items from existing construction in a manner to prevent damage. Clean, package, label and deliver salvaged items to District in ready-for-reuse condition.
- H. Remove and Reinstall: Detach or dismantle items from existing construction in a manner to prevent damage. Clean and prepare for reuse and reinstall where indicated.
- I. Reuse: The use, in the same or similar form as it was produced, of a material which might otherwise be discarded.
- J. Existing to Remain: Designation for existing items that are not to be removed and that are not otherwise indicated to be salvaged or reinstalled.
- K. Waste:
1. Chemical Waste: Includes petroleum products, bituminous materials, salts, acids, alkalis, herbicides, pesticides, organic chemicals and inorganic wastes.

2. Solid Waste: All putrescible and nonputrescible solid, semisolid, and liquid wastes, including garbage, trash, refuse, paper, rubbish, ashes, industrial wastes, demolition and construction wastes, abandoned vehicles and parts thereof, discarded home and industrial appliances, dewatered, treated, or chemically fixed sewage sludge which is not hazardous waste, manure, vegetable or animal solid and semisolid wastes, and other discarded solid and semisolid wastes. "Solid waste" does not include hazardous waste, radioactive waste, or medical waste as defined or regulated by State law.

1.04 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.
- B. CBC Ch. 33 - Safeguards During Construction; current adopted edition.
- C. CFC Ch. 33 - Fire Safety During Construction and Demolition; Current Edition.
- D. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations; 2022, with Errata (2021).

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Pre-Construction Conference: Conduct a pre-construction conference one week prior to the start of the work of this section; require attendance by all affected trades.
- B. Convene a conference at the Project site 3 days prior to starting demolition to review the Drawings and Specifications, requirements of authorities having jurisdiction, instructions and requirements of serving utilities, sequencing and interface considerations and project conditions.
- C. Conference shall be attended by Construction Manager, supervisory and quality control personnel of Contractor and all subcontractors performing this and directly-related Work.
- D. Submit minutes of meeting to District, Project Inspector and Architect, for Project record purposes.
- E. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.06 MATERIALS OWNERSHIP

- A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain property of Santa Maria-Bonita School District, demolished materials shall become the Contractor's property and shall be removed, recycled, or disposed from Project site in an appropriate and legal manner.
 1. Arrange a meeting no less than ten (10) days prior to demolition with the District or Construction Manager and other designated representatives to review any salvageable items to determine if District wants to retain ownership, and discuss Contractor's Waste Management and Recycling Plan.
- B. Storage or sale of removed items or materials on-site will not be permitted without advance written approval from Construction Manager.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Site Plan: Indicate:
 1. Vegetation to be protected.
 2. Areas for temporary construction and field offices.
 3. Areas for temporary and permanent placement of removed materials.
- C. Demolition Plan: Submit demolition plan as required by OSHA and local AHJs.

1. Indicate extent of demolition, removal sequencing, bracing and shoring, and location and construction of barricades and fences.
2. Demolition firm qualifications.
- D. Demolition phase:
 1. Proposed dust-control measures.
 2. Proposed noise-control measures.
 3. Schedule of demolition activities indicating the following:
 - a. Detailed sequence of demolition and removal work, including start and end dates for each activity.
 - b. Dates for shutoff, capping, and continuation of utility services.
 4. If hazardous materials are encountered and disposed of, landfill records indicating receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.
 5. Contractor's Waste Management and Recycling Plan: See Section 01 74 19 - Construction Waste Management and Disposal.
 - a. This plan will not otherwise relieve the Contractor of responsibility for adequate and continuing control of pollutants and other environmental protection measures.
 6. Contractor's Reuse, Recycling, and Disposal Report: See Section 01 74 19 - Construction Waste Management and Disposal.
- E. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.
 1. Record drawings: Identify and accurately locate capped utilities and other subsurface structural, electrical, or mechanical conditions.

1.08 SUBMITTALS

- A. Demolition and Removal Procedures and Schedule: Submit for Project record only.
- B. Project Record Drawings: Submit in accordance with provisions specified in Section 01 78 00 - Closeout Submittals. Indicate verified locations of underground utilities and storm drainage system on project record drawings.

1.09 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 1. Minimum of 5 years of documented experience.

1.10 SCHEDULING

- A. Schedule Work to precede new construction.
- B. Describe demolition removal procedures and schedule.
- C. Perform work between the hours of 8am and 5pm, subject to noise abatement regulations and District's approval for noise considerations.

PART 2 PRODUCTS -- NOT USED

PART 3 EXECUTION

3.01 DEMOLITION

- A. Remove the entire building as indicated on Architectural Demolition Site Plan AD1.1.
 - 1. Demolish buildings completely and remove from the site. Use methods required to complete Work within limitations of governing regulations:
 - a. Locate demolition equipment throughout the building and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
 - b. Demolish concrete and masonry in sizes that will be suitable for acceptance at recycling or disposal facilities.
 - c. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
 - d. Break up and remove concrete slabs on grade in small sizes, suitable for acceptance at recycling or disposal facilities, unless otherwise shown to remain.
 - e. Remove all disconnected, abandoned utilities on site.
- B. Remove paving and curbs required to accomplish new work.
- C. Remove all other paving and curbs within construction limits indicated on drawings.
- D. Within area of new construction, remove foundation walls and footings to minimum 2 feet below finished grade.
 - 1. Below-Grade Construction: Demolish foundation walls and other below-grade construction:
 - a. Completely remove below-grade construction, including foundation walls and footings, unless indicated otherwise on Drawings.
 - b. Break up and completely remove below-grade concrete slabs, in small sizes, suitable for acceptance at recycling or disposal facilities.
 - c. Below-Grade Areas: Completely fill below-grade areas and voids resulting from building demolition operations to street level with satisfactory soil materials.
- E. Remove concrete slabs on grade within construction limits indicated on drawings.
- F. Remove manholes and manhole covers, curb inlets and catch basins.
- G. Remove fences and gates.
- H. Remove other items indicated, for salvage, relocation, and recycling.
- I. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 22 00.

3.02 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Conform to the relevant Article of the General Conditions, South Coast Air Quality Management District and other applicable regulatory procedures when discovering hazardous or contaminated materials.
- B. Selective Demolition of Site and Building Elements:
 - 1. Use techniques acceptable to authorities having jurisdiction and which will achieve intended results and provide protection of surrounding features to remain.

2. Some items may have been demolished prior to Work of this Contract. Verify existing conditions prior to start of demolition. If items are or have been demolished contact the Architect.
 3. Some items may require postponement of demolition until late in Contract Time period.
 4. Phase demolition as necessary to provide adequate interfacing of related Work.
 5. Demolish in an orderly and careful manner. Protect existing foundations, retaining walls, utility structures, other structures and finish materials to remain.
- C. Field Measurements and Conditions:
1. Survey existing conditions and correlate with requirements indicated to determine extent of demolition and recycling required.
 2. In addition to provisions of the Conditions of the Contract, verify dimensions and field conditions prior to construction. Verify condition of substrate and adjoining Work before proceeding with demolition Work. If conflict is found notify Construction Manager, Project Inspector and Architect.
- D. Comply with requirements in Section 01 70 00.
- E. Comply with governing EPA notification regulations before starting demolition. Comply with hauling and disposal regulations of authorities having jurisdiction. Obtain and pay for all permits required.
- F. Environmental Controls
1. Comply with federal, state and local regulations pertaining to water, air, solid waste, recycling, chemical waste, sanitary waste, sediment and noise pollution.
 2. Protection of Natural Resources: Preserve the natural resources within the project boundaries or restore to an equivalent condition.
 3. Confine demolition activities to areas defined by public roads, easements, and work area limits indicated on the drawings.
 4. Temporary Construction: Remove indications of temporary construction facilities, such as haul roads, work areas, structures, stockpiles or waste areas.
 5. Water Resources: Comply with applicable regulations concerning the direct or indirect discharge of pollutants to underground and natural surface waters.
 - a. Oily Substances: Prevent oily or other hazardous substances from entering the ground, drainage areas, or local bodies of water in such quantities as to affect normal use, aesthetics, or produce a measurable ecological impact on the area.
 - 1) Store and service construction equipment at areas designated for collection of oil wastes.
 6. Dust Control, Air Pollution, and Odor Control: Prevent creation of dust, air pollution and odors.
 - a. Use temporary enclosures and other appropriate methods to limit dust and dirt rising and scattering in air to lowest practical level.
 - b. Store volatile liquids, including fuels and solvents, in closed containers.
 - c. Properly maintain equipment to reduce gaseous pollutant emissions.
 7. Noise Control: Perform demolition operations to minimize noise.
 - a. Repetitive, high level impact noise will be permitted only during the times indicated in Section 01 70 00 - Execution and Closeout Requirements.
- G. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.

1. Obtain required permits.
2. Comply with applicable requirements of NFPA 241, CBC Ch. 33, and CFC Ch. 33.
3. Use of explosives is not permitted.
4. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - a. Survey condition of the building to determine whether removing any element might result in a structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during demolition.
 - 1) Retain a licensed and qualified civil or structural engineer to provide analysis, including calculations, necessary to ensure the safe execution of the demolition work.
 - b. Prevent movement or settlement of adjacent structures. Provide bracing and shoring.
 - c. Perform surveys as the Work progresses to detect hazards resulting from demolition activities.
5. Provide, erect, and maintain temporary barriers and security devices.
 - a. Provide, erect, and maintain temporary barriers, safety and security devices , for protection of streets, sidewalks, curbs, adjacent property and the public.
 - b. Protection: Protect existing construction and adjacent areas with temporary barriers and security devices in accordance with requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
 - 1) Review location and type of construction of temporary barriers with District and/or the Construction Manager.
 - 2) Barriers shall control dust, debris and provide protection for persons occupying and using adjacent facilities.
 - 3) Maintain protected egress and access at all times, in accordance with requirements of authorities having jurisdiction and with permission of DSA (AHJ having jurisdiction).
6. Use physical barriers to prevent access to areas that could be hazardous to workers or the public.
7. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
8. Do not close or obstruct roadways or sidewalks without permits from authority having jurisdiction.
9. Conduct operations to minimize obstruction of public and private entrances and exits. Do not obstruct required exits at any time. Protect persons using entrances and exits from removal operations.
10. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon, or limit access to their property.
- H. Do not begin removal until receipt of notification to proceed from District.
- I. Do not begin removal until built elements to be salvaged or relocated have been removed.
- J. Do not begin removal until vegetation to be relocated has been removed and vegetation to remain has been protected from damage.
- K. Protect existing structures and other elements to remain in place and not removed.
 1. Provide bracing and shoring.

2. Prevent movement or settlement of adjacent structures.
3. Stop work immediately if adjacent structures appear to be in danger.
4. Protect existing landscaping materials, appurtenances, structures and items that are not to be demolished, or are on adjacent property.
5. Mark location of utilities.
- L. Minimize production of dust due to demolition operations. Do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- M. Hazardous Materials:
 1. Hazardous Materials: Comply with 29 CFR 1926 and state and local regulations.
- N. Remove materials to be re-installed or retained in manner to prevent damage. Store and protect in accordance with requirements of Section 01 60 00 - Product Requirements.
- O. Perform demolition in a manner that maximizes salvage and recycling of materials.
 1. Comply with requirements of Section 01 74 19 - Construction Waste Management and Disposal.
 2. Dismantle existing construction and separate materials.
 3. Set aside reusable, recyclable, and salvageable materials; store and deliver to collection point or point of reuse.
- P. Damages: Promptly repair damages to adjacent facilities caused by demolition operations.
- Q. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.03 EXISTING UTILITIES

- A. Coordinate work with utility companies. Notify utilities before starting work, comply with their requirements, and obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to District.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to District.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove exposed piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. Prepare building demolition areas by disconnecting and capping utilities outside the demolition zone. Identify and mark, in same manner as other utilities to remain, utilities to be reconnected.

3.04 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove materials not to be reused on site; comply with requirements of Section 01 74 19 - Waste Management.
- C. Remove temporary work.
- D. Leave site in clean condition, ready for subsequent work.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

- E. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

SECTION 03 10 00 - CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 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. Form-facing material for cast-in-place and architectural concrete.
 - 2. Form liners.
 - 3. Insulating concrete forms.
 - 4. Shoring, bracing, and anchoring.
- B. Related Requirements:
 - 1. Section 03 30 00 "Cast-in-Place concrete" for concrete materials, mixture design, and placement procedures.
 - 2. [Section 03 35 00 "Concrete Finishing" for curing, floor treatments, miscellaneous concrete items, and finishing of concrete.]
 - 3. [Section 07 26 00 "Vapor Retarders"]
 - 4. [Section 32 13 13 "Concrete Paving" for concrete pavement and walks.]
 - 5. [Section 32 13 16 "Decorative Concrete Paving" for decorative concrete pavement and walks.]
- C. Reference Documents:
 - 1. Building Code: [As indicated on drawings].
 - 2. ACI - American Concrete Institute,
 - a. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - b. ACI 301, "Specification for Structural Concrete for Buildings".
 - c. ACI 302.1R "Guide for Concrete Floor and Slab Construction".
 - d. ACI 303.1 "Standard Specification for Cast-in-Place Architectural Concrete"
 - e. ACI 347.3R "Guide to Formed Concrete Surfaces".
 - 3. ASTM - American Society for Testing and Materials, designations referenced herein.
 - 4. ICC-ES - International Code Council Evaluation Services, Evaluation Reports referenced herein.

1.3 DEFINITIONS

- A. Form-Facing Material: Temporary structure or mold for the support of concrete while the concrete is setting and gaining sufficient strength to be self-supporting.
- B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each of the following:
 - 1. Exposed surface form-facing material.
 - 2. Concealed surface form-facing material.
 - 3. Pan-type forms.
 - 4. Void forms.
 - 5. Form liners.
 - 6. Insulating concrete forms.
 - 7. Form ties.
 - 8. Chamfer strips grooves and reveals.
 - 9. Waterstops.
 - 10. Pre-formed construction joints.
 - 11. Form-release agent.
- B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional engineer responsible for their preparation, detailing fabrication, assembly, and support of forms.
 - 1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
 - 2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301, ACI 347, and ACI 303.1.
 - a. Location of construction joints is subject to approval of the Architect.
 - 3. Indicate location of waterstops.
 - 4. Indicate form liner layout and form line termination details.
 - 5. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
- C. Samples:
 - 1. Waterstops.
 - 2. Form Liners: 12-inch by 12-inch (305-mm by 305-mm) sample, indicating texture.
 - 3. Chamfer, drip, groove, and reveal strips.]
- D. Coordination Drawings: Plans, sections and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Provide layout of all items to be embed in concrete including supports for mechanical, plumbing and electrical systems, architectural cladding and finishes, etc.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing and inspection agency.
- B. Research Reports: For insulating concrete forms indicating compliance with International Code Council Acceptance Criteria AC308.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing and Inspection Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Form materials: Protect materials from damage, weather and contamination such as rust, grease, oil and dirt. Contaminated formwork materials shall not be used or reused unless thoroughly cleaned and approved for use by the Architect.
- B. Form Liners: Store form liners under cover to protect from sunlight.
- C. Insulating Concrete Forms: Store forms off ground and under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.
- D. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design wood panel forms in accordance with APA's "Concrete Forming Design/Construction Guide."
 - 2. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.
 - a. For architectural concrete specified in Section 03 33 00 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).
- B. Design, engineer, erect, shore, brace, and maintain insulating concrete forms in accordance with ACI 301 (ACI 301M), to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that resulting concrete conforms to the required shapes, lines, and dimensions.
 - 1. Design cross ties to transfer the effects of the following loads to the cast-in-place concrete core:
 - a. Wind Loads: As indicated on Drawings.
 - 1) Horizontal Deflection Limit: Not more than 1/360 of the wall height.

2.2 FORM-FACING MATERIALS

- A. As-Cast Surface Form-Facing Material:
 - 1. Provide continuous, true, and smooth concrete surfaces.
 - 2. Furnish in largest practicable sizes to minimize number of joints.

3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete, and as follows:
 - a. Plywood, metal, or other approved panel materials.
 - b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
 - 1) APA Plyform Class I, B-B or better; mill oiled and edge sealed.
- B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.
 1. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Pan-Type Forms: Glass-fiber-reinforced plastic or formed steel, stiffened to resist plastic concrete loads without detrimental deformation.
- D. Void Forms:
 1. Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
 2. Expanded polystyrene manufactured in accordance with ASTM C578

2.3 WATERSTOPS

- A. Flexible Rubber Waterstops: U.S. Army Corps of Engineers CRD-C 513, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricated corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick
- B. Chemically Resistant Flexible Waterstops: Thermoplastic elastomer rubber waterstops with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints; resistant to oils, solvents, and chemicals, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick
- C. Flexible PVC Waterstops: U.S. Army Corps of Engineers CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory fabricate corners, intersections, and directional changes.
 1. Profile: Flat dumbbell with center bulb
 2. Dimensions: 4 inches by 3/16 inch thick
- D. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch
- E. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, 3/8 by 3/4 inch

2.4 RELATED MATERIALS

- A. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

- B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch (0.85 mm) thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.
- C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.
- D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
 - 2. Form release agent for form liners shall be acceptable to form liner manufacturer.
- F. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

- A. Comply with ACI 301.
- B. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- C. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 03 30 00 "Cast-In-Place Concrete" and Section 03 35 43 "Polished Concrete Finishing.
- D. Limit concrete surface irregularities as follows:
 - 1. Surface Finish-3.0: ACI 117 [Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Surface Finish-2.0: ACI 117 [Class B, 1/4 inch] for standard-formed finished surfaces
 - 3. [Class C, 1/2 inch]
 - 4. Surface Finish-1.0: ACI 117 [Class D, 1 inch] for rough-formed finished surfaces.
- E. Construct forms tight enough to prevent loss of concrete mortar.
 - 1. Minimize joints.
 - 2. Exposed Concrete: Symmetrically align joints in forms.

- F. Construct removable forms for easy removal without hammering or prying against concrete surfaces.
 - 1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
 - 2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 3. Install keyways, reglets, recesses, and other accessories, for easy removal.
- G. Do not use rust-stained, steel, form-facing material.
- H. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.
 - 1. Provide and secure units to support screed strips
 - 2. Use strike-off templates or compacting-type screeds.
- I. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.
 - 1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
 - 2. Locate temporary openings in forms at inconspicuous locations.
- J. [Chamfer] corners and edges of permanently exposed concrete.
- K. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.
- L. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
 - 1. Determine sizes and locations from trades providing such items.
 - 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- M. Construction and Movement Joints:
 - 1. Construct joints true to line with faces perpendicular to surface plane of concrete.
 - 2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 - 3. Place joints perpendicular to main reinforcement.
 - 4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
 - a. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 - 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 - 6. Space vertical joints in walls as indicated on Drawings.
 - a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- N. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
 - 1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 - 2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- O. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- P. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

- Q. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- R. Formwork shall be new at the start of the job. Forms may be reused, provided they are thoroughly cleaned of dirt, mortar, oil, rust, and foreign materials, and are undamaged at edges and contact faces. Reuse of forms shall be subject to approval by the Architect.

3.2 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.
 - 1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
 - 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
 - 4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
 - 5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

- A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 03 30 00 "Cast-In-Place Concrete."
 - 4. Secure waterstops in correct position at 12 inches (305 mm) on center.
 - 5. Field fabricate joints in accordance with manufacturer's instructions using heat welding.
 - a. Miter corners, intersections, and directional changes in waterstops.
 - b. Align center bulbs.
 - 6. Clean waterstops immediately prior to placement of concrete.
 - 7. Support and protect exposed waterstops during progress of the Work.
- B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.
 - 1. Install in longest lengths practicable.
 - 2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
 - 3. Protect exposed waterstops during progress of the Work.

3.4 INSTALLATION OF INSULATING CONCRETE FORMS

- A. Comply with ACI 301 and manufacturer's instructions.
- B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Install forms in running bond pattern.

1. Align joints.
 2. Align furring strips.
- D. Construct forms tight to prevent loss of concrete mortar.
- E. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.
1. Determine sizes and locations from trades providing such items.
 2. Obtain written approval of Architect prior to forming openings not indicated on Drawings.
- F. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.
1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
 2. Close temporary ports and openings with tight fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.
- G. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- H. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- I. Shore insulating concrete forms to ensure stability and to resist stressing imposed by construction loads.

3.5 REMOVING AND REUSING FORMS

- A. Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 36 hours after placing concrete. Concrete must be hard enough to not be damaged by form-removal operations and curing and protection operations need to be maintained.
1. Do not proceed with formwork removal until the concrete members have attained sufficient strength, minimum of 100 percent of 28-day strength and stiffness to safely support the imposed loads, unless noted otherwise on drawings. Confirmation of design strength shall be verified by breaking of field cured cylinders, taken in addition to those required for Owner's QA and shall be done at Contactor's expense. In addition, the minimum times for removal of formwork after concrete has been placed shall be as indicated on drawings.
 2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.
- B. Clean and repair surfaces of forms to be reused in the Work.
1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
 2. Apply new form-release agent.
- C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.
1. Align and secure joints to avoid offsets.
 2. Do not use patched forms for exposed concrete surfaces unless approved by Architect.
- D. Comply with ACI 318 section 26.11 for removal of formwork.

3.6 TOLERANCES

- A. Formwork for standard and architectural concrete shall be constructed such that the shapes, sizes, lines, and dimensions of cast-in-place concrete shown on the Drawings conform to the tolerances listed in the Section entitled "Cast-In-Place Concrete".
- B. Offsets between adjacent formwork facing materials for rough finish, concealed surface concrete formwork shall conform to ACI 117 Class C requirements.
- C. Offsets between adjacent formwork facing materials for smooth finish, exposed surface concrete formwork shall conform to ACI 117 Class B requirements.

3.7 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
 - 1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
 - 2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

END OF SECTION 03 10 00

SECTION 03 20 00 - CONCRETE REINFORCING

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. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 03 10 00 "Concrete Formwork" for materials and construction of concrete forms.
2. Section 03 30 00 "Cast-in-Place Concrete" for cast-in-place concrete mix design and concrete strength testing of laboratory- and field-cured cylinders.
3. [Section 03 35 00 "Concrete Finishing" for curing and finishing of concrete.]
4. [Section 32 13 13 "Concrete Paving" for reinforcing related to concrete pavement and walks.]
5. [Section 32 13 16 "Decorative Concrete Paving" for reinforcing related to decorative concrete pavement and walks.]

C. Reference Documents:

1. Building Code: [As indicated on drawings]
2. ACI - American Concrete Institute,
 - a. ACI 117, "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - b. ACI 301, "Specification for Structural Concrete for Buildings".
 - c. ACI 315, "Details and Detailing of Concrete Reinforcement".
3. ASTM - American Society for Testing and Materials, designations referenced herein.
4. AWS - American Welding Society,
 - a. AWS D1.1, "Structural Welding Code - Steel".
 - b. AWS D1.4, "Structural Welding Code - Reinforcing Steel".
5. CRSI - Concrete Reinforcing Steel Institute,
 - a. CRSI MSP-1, "Manual of Standard Practice".
 - b. CRSI, "Placing Reinforcing Bars".
6. ICC-ES - International Code Council Evaluation Services, Evaluation Reports referenced herein.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Bar supports.
3. Reinforcing bar terminators
4. Deformed bar anchors

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.
3. Shop drawings shall include plan, elevation, and detail views with project grids accurately indicating bar material type, size, lengths, locations, bends, lap splice lengths and locations, welded splice locations, mechanical coupler locations and headed bar locations.
4. Layering and sequencing information for intersections shall be identified.
5. Coordinate and include placement diagrams of embedded items such as anchor bolts, inserts, etc.
6. Shop drawings shall not include copies of Contract Document details. References to Contract Document details in lieu of details prepared as part of placing drawing submittals will not be accepted.
7. Shop drawings shall list the structural materials included in the submittal. Reinforcement shown on placing drawings illustrating sequencing, layering, or intersections, but not included in the placing drawing bar lists, shall be identified as "previously submitted" or "to be submitted."

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

B. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M

C. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:
 - a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.
2. Mechanical splice couplers
3. Reinforcing bar terminators

- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, acceptable to the authority having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
- B. The Testing Agency shall perform the required tests and inspections, prepare written summary reports of tests and inspections, and review submittals.
- C. The Testing Agency shall inspect material, size, spacing, arrangement, placement, and cover of reinforcing.
- D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.
 - 1. Store reinforcement to avoid contact with earth.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.
- B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, Grade 60, deformed.
- C. Steel Bar Mats: ASTM A 184/A 184M, fabricated from ASTM A 615/A 615M, Grade 60 or ASTM A 706/A 706M deformed bars, as indicated on drawings, assembled with clips.
- D. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

2.2 REINFORCEMENT ACCESSORIES

- A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.
- B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire or plastic according to CRSI's "Manual of Standard Practice," and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.

2. Use precast concrete spacers of greater compressive strength than concrete at location in contact with ground.
3. shall conform to ASTM A108 and have a head area ten times the shaft area.]
- C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.
 1. Finish: Galvanized.

2.3 FABRICATING REINFORCEMENT

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

PART 3 - EXECUTION

3.1 PREPARATION

- A. Protection of In-Place Conditions:
 1. Do not cut or puncture vapor retarder.
 2. Repair damage and reseal vapor retarder before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

- A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.
- B. Accurately position, support, and secure reinforcement against displacement.
 1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
 2. Do not tack weld crossing reinforcing bars.
- C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.
- D. Provide concrete coverage in accordance with ACI 318.
- E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- F. Splices: Lap splices as indicated on Drawings.
 1. Bars indicated to be continuous, and all vertical bars shall be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
 2. Stagger splices in accordance with ACI 318.
 3. Weld reinforcing bars in accordance with AWS D1.4/D 1.4M, where indicated on Drawings.
- G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."
 - a. For reinforcement less than W4.0 or D4.0, continuous support spacing shall not exceed 12 inches.
2. Lap edges and ends of adjoining sheets at least two wire spacing and 8 inches minimum for plain wire and deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
4. Lace overlaps with wire.

3.3 JOINTS

- A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
 1. Place joints perpendicular to main reinforcement.
 2. Continue reinforcement across construction joints unless otherwise indicated.
 3. Do not continue reinforcement through sides of strip placements of floors and slabs.
- B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

- A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a special inspector and qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. [Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.]
- C. Inspections:
 1. Steel-reinforcement placement.
 2. Steel-reinforcement mechanical splice couplers.
 3. Steel-reinforcement welding.
 4. Embeds, headed bolts and studs.

END OF SECTION 03 20 00

SECTION 03 30 00 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Cast-in-place concrete, including concrete materials, mixture design, and placement procedures.
- B. Related Requirements:
 - 1. Section 03 10 00 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
 - 2. Section 03 20 00 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
 - 3. [Section 03 35 00 "Concrete Finishing" for curing, floor treatments, miscellaneous concrete items, and finishing of concrete.]
 - 4. [Section 05 12 00 "Structural Steel" for grouting of base plates.]
 - 5. [Section 07 26 00 "Vapor Retarders"]
 - 6. [Section 09 96 00 "High-Performance Coatings"]
 - 7. [Section 31 23 16 "Base Course" for drainage fill under slabs-on-ground.]
 - 8. [Section 32 13 13 "Concrete Paving" for concrete pavement and walks.]
 - 9. [Section 32 13 16 "Decorative Concrete Paving" for decorative concrete pavement and walks.]
- C. Reference Documents:
 - 1. Building Code: [As indicated on drawings].
 - 2. ACI - American Concrete Institute,
 - a. ACI 117 "Standard Specifications for Tolerances for Concrete Construction and Materials".
 - b. ACI 211.1 "Recommended Practice for Selecting Proportions for Normal and Heavy Weight Concrete".
 - c. ACI 211.2 "Standard Practice for Selecting Proportions for Structural Lightweight Concrete".
 - d. ACI 223R-10 "Guide for the Use of Shrinkage-Compensating Concrete".
 - e. ACI 301, "Specification for Structural Concrete for Buildings".
 - f. ACI 302.1R "Guide for Concrete Floor and Slab Construction".
 - g. ACI 303.1 "Standard Specification for Cast-in-Place Architectural Concrete"
 - h. ACI 304R "Recommended Practice for Measuring, Mixing, Transporting and Placing Concrete".
 - i. ACI 304.2R "Placing Concrete by Pumping Methods".
 - j. ACI 305.1 "Specification for Hot Weather Concreting".
 - k. ACI 306R "Cold Weather Concreting".

- l. ACI 308R "Guide to Curing Concrete".
- m. ACI 309R "Guide for Consolidation of Concrete".
- n. ACI 318 "Building Code Requirements for Structural Concrete".
- o. ACI 347.3R "Guide to Formed Concrete Surfaces".
- 3. ASTM - American Society for Testing and Materials, designations referenced herein.
- 4. ICC-ES - International Code Council Evaluation Services, Evaluation Reports referenced herein.
- 5. NRMCA - National Ready-Mix Concrete Association, Quality Control Manual – Section 3: Certification of Ready Mixed Concrete Production Facilities

1.3 DEFINITIONS

- A. Cementitious Materials: Ordinary Portland Cement (OPC) alone or in combination with one or more of the following: Portland Limestone Cement (PLC), blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.
- B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.
- C. High Volume Fly Ash Mixes (HVFA): Concrete mixes where fly ash or other pozzolans exceeds 25% of cementitious material.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.
 - 1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete Subcontractor.
 - e. Reinforcing subcontractor.
 - f. [Concrete mix designer.]
 - g. [Special concrete finish Subcontractor.]
 - 2. Review the following:
 - a. Special inspection and testing and inspecting agency procedures for field quality control.
 - b. Ready-mix delivery and placement logistics.
 - c. Construction joints, control joints, isolation joints, and joint-filler strips.
 - d. Semirigid joint fillers.
 - e. Vapor-retarder installation.
 - f. Steel-reinforcement installation
 - g. Anchor rod and anchorage device installation tolerances.
 - h. Cold and hot weather concreting procedures.
 - i. Concrete finishes and finishing.
 - j. Curing procedures.
 - k. Forms and form-removal limitations.
 - l. Architectural Concrete
 - m. Shoring and reshoring procedures.
 - n. Methods for achieving specified floor and slab flatness and levelness.
 - o. Floor and slab flatness and levelness measurements.
 - p. Concrete repair procedures.

- q. Concrete protection.
- r. Initial curing and field curing of field test cylinders.
- s. Protection of field cured field test cylinders.

1.5 ACTION SUBMITTALS

A. Product Data: For each of the following.

- 1. Portland cement.
- 2. Portland limestone cement.
- 3. Fly ash.
- 4. Slag cement.
- 5. Blended hydraulic cement.
- 6. Silica fume.
- 7. Performance-based hydraulic cement
- 8. Aggregates.
- 9. Color pigments.
- 10. Admixtures:
 - a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
- 11. [Vapor retarders.]
- 12. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

- 1. Mixture identification.
- 2. Member types and specific placement locations for which the mix is intended.
- 3. Concrete class.
- 4. Durability exposure class.
- 5. Design compressive strength, age (in days) required to reach design compressive strength, and compressive strength historic data.
- 6. Cementitious Material quantities per cubic yard.
- 7. Maximum w/cm.
- 8. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
- 9. Calculated equilibrium unit weight, for lightweight concrete.
- 10. Design slump (or target slump range for self-consolidating mixes) at point of discharge from transit mix truck.
- 11. Air content.
- 12. Nominal maximum aggregate size.
- 13. Course and fine aggregate sources, types, sizes, and gradation.
- 14. [Include manufacturer's certification that permeability-reducing admixture is compatible with mix design.]
- 15. [Include certification that dosage rate for permeability-reducing admixture matches dosage rate used in performance compliance test.]
- 16. Intended placement method.
- 17. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
- 18. Mixes shall be designed by a qualified testing laboratory and be sealed by a registered Professional Engineer in the authority having jurisdiction.

- C. Shop Drawings:
 - 1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - a. Location of construction joints is subject to approval of the Architect.
- D. Concrete Schedule: For each location of each Class of concrete indicated in "Concrete Mixtures" Article, including the following:
 - 1. Concrete Class designation.
 - 2. Location within Project.
 - 3. Exposure Class designation.
 - 4. Formed Surface Finish designation and final finish.
 - 5. Final finish for floors.
 - 6. Curing process.
 - 7. Floor treatment if any.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For the following:
 - 1. Installer: Include copies of applicable ACI certificates.
 - 2. Ready-mixed concrete manufacturer.
- B. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. [Vapor retarders.]
 - 4. Repair materials.
- C. Material Test Reports: For the following, from a qualified testing agency:
 - 1. Portland cement.
 - 2. Portland limestone cement.
 - 3. Fly ash.
 - 4. Slag cement.
 - 5. Blended hydraulic cement.
 - 6. Silica fume.
 - 7. Performance-based hydraulic cement.
 - 8. Aggregates.
 - a. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
 - 9. Admixtures:
 - a. Permeability-Reducing Admixture: Include independent test reports, indicating compliance with specified requirements, including dosage rate used in test.
- D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.
- E. Research Reports:
 - 1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
 - 2. [For sheet vapor retarder/termite barrier, showing compliance with ICC AC380.]
- F. Preconstruction Test Reports: For each mix design.
- G. Field quality-control reports.

- H. Weighmaster Batch Tickets: Provide copies of each delivery to Testing Agency, at the time of delivery.
- I. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.
 - 1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.
- B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.
 - 1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated and employing an ACI-certified Concrete Quality Control Technical Manager.
 - 1. Personnel performing laboratory tests shall be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Grade I. Testing agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician, Grade II.
- D. Field Quality Control Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.
 - 1. Personnel conducting field tests shall be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with ACI CPP 610.1 or an equivalent certification program.

1.8 PRECONSTRUCTION TESTING

- A. Preconstruction Testing Service: Engage a qualified Testing Agency to perform preconstruction testing on each concrete mixture.
 - 1. Include the following information in each test report:
 - a. Admixture dosage rates.
 - b. Slump.
 - c. Air content.
 - d. 7-day compressive strength.
 - e. 28-day compressive strength.
 - f. 56-day compressive strength for HVFA mixes.
 - g. Permeability.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Comply with ASTM C94 and ACI 301.

1.10 FIELD CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301 and ACI 306.1 and as follows.
 - 1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg F (1.7 deg C), other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

- A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

- A. Source Limitations:
 - 1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
 - 2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
 - 3. Obtain aggregate from single source.
 - 4. Obtain each type of admixture from single source from single manufacturer.
- B. Cementitious Materials:
 - 1. Portland Cement: ASTM C150, Type Per Structural Drawings.
 - 2. Portland Limestone Cement: ASTM C595, Type Per Structural Drawings.
 - 3. Fly Ash: ASTM C618, Class F.
 - 4. Slag Cement: ASTM C989, Grade 100 or 120.
 - 5. Blended Hydraulic Cement: ASTM C595.
 - 6. Silica Fume: ASTM C1240 amorphous silica.
- C. Normal-Weight Aggregates: ASTM C33/C33M. Provide aggregates from a single source.
 - 1. [Alkali-Silica Reaction: Comply with one of the following:
 - a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.

- b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
 - c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. for moderately reactive aggregate or 3 lb./cu. Yd. for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301.]
 - 2. Maximum Coarse-Aggregate Size:[As indicated on drawings].
 - 3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
- D. Lightweight Aggregate: ASTM C 330, 1/2-inch nominal maximum aggregate size.
- E. Air-Entraining Admixture: ASTM C260/C260M.
- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494, Type A.
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and -Retarding Admixture: ASTM C494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - 5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 - 7. [Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete and complying with ASTM C494, Type C.]
 - 8. [Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.]
 - 9. [Permeability-Reducing Admixture: ASTM C494, Type S, hydrophilic, permeability-reducing crystalline admixture, capable of reducing water absorption of concrete exposed to hydrostatic pressure (PRAH).
 - a. Permeability: No leakage when tested in accordance with U.S. Army Corps of Engineers CRC C48 at a hydraulic pressure of 200 psi for 14 days.]
- G. Color Pigment: ASTM C979/C979M, synthetic mineral-oxide pigments, color stable, nonfading, and resistant to lime and other alkalis.
 - 1. Color: Match Architect's sample
- H. Water and Water Used to Make Ice: ASTM C94/C94M and potable.

2.3 LIQUID FLOOR TREATMENTS

- A. See Section 03 35 00 for liquid floor treatment requirements.

2.4 CURING MATERIALS

- A. See Section 03 35 00 for curing material requirements.

2.5 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: See Section 03 35 00 for requirements.
- B. Semirigid Joint Filler: See Section 03 35 00 for requirements.
- C. Bonding Agent: See Section 03 35 00 for requirements.
- D. Epoxy Bonding Adhesive: See Section 03 35 00 for requirements.
- E. Floor Slab Protective Covering: See Section 03 35 00 for requirements.

2.6 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 6000psi at 28 days when tested in accordance with ASTM C109/C109M.
- B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C150 portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
 - 2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
 - 4. Compressive Strength: Not less than 6000psi at 28 days when tested in accordance with ASTM C109.

2.7 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.
 - 1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.
- B. Cementitious Materials:
 - 1. Use fly ash, pozzolans, slag cement, silica fume, and Portland Limestone Cement as needed to reduce the total amount of ordinary portland cement, which would otherwise be used, by not less than 40 percent by mass.
 - 2. See drawings for specified 28-day concrete strengths and limit the maximum Ordinary Portland Cement content used in concrete mixtures as follows:
 - a. Normal-weight Concrete up to 2,500 psi: 362 lb/cu. yd

- b. Normal-weight Concrete 2501 to 3000 psi: 410 lb/cu. yd
 - c. Normal-weight Concrete 3001 to 4000 psi: 456 lb/cu. yd
 - d. Normal-weight Concrete 4001 to 5000 psi: 503 lb/cu. yd
 - e. Normal-weight Concrete 5001 to 6000 psi: 531 lb/cu. yd
 - f. Normal-weight Concrete 6001 to 7000 psi: 594 lb/cu. yd
 - g. Normal-weight Concrete 7001 psi and higher: 657 lb/cu. yd
 - h. Light-weight Concrete up to 3,000 psi: 512 lb/cu. yd
 - i. Light-weight Concrete 3001 to 4000 psi: 571 lb/cu. yd
 - j. Light-weight Concrete 4001 to 5000 psi: 629 lb/cu. yd
- C. Limit water-soluble, chloride-ion content in hardened concrete to [0.06] [0.15] [0.30] [1.00] percent by weight of cement.
- D. Admixtures: Use admixtures in accordance with manufacturer's written instructions.
- 1. Use water-reducing, high-range water-reducing or plasticizing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use corrosion-inhibiting admixture in concrete mixtures where indicated.
 - 4. Use permeability-reducing admixture in concrete mixtures where indicated.
- E. Color Pigment: Add color pigment to concrete mixture in accordance with manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

2.8 CONCRETE MIXTURES

- A. All mixes shall meet requirements of Structural Drawings.

2.9 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94 and ASTM C1116, and furnish batch ticket information.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verification of Conditions:
- 1. Before placing concrete, verify that installation of concrete forms, accessories, and reinforcement, and embedded items is complete and that required inspections have been performed.
 - 2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 INSTALLATION OF EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.
1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of ANSI/AISC 303.
 3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.4 JOINTS

- A. Construct joints true to line, with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.
1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by Architect.
 2. Place joints perpendicular to main reinforcement.
 - a. Continue reinforcement across construction joints unless otherwise indicated.
 - b. Do not continue reinforcement through sides of strip placements of floors and slabs.
 3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
 4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
 7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- C. Control Joints in slab-on-grade: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch (3.2 mm). Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
 2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when

cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

- D. Isolation Joints in slab-on-grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
 - 1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
 - 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 07 92 00 "Joint Sealants," are indicated.
 - 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- E. Doweled Joints:
 - 1. Install dowel bars and support assemblies at joints where indicated on Drawings.
 - 2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.5 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.
 - 1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
 - 2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.
- B. Notify Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301, but not to exceed the amount indicated on the concrete delivery ticket.
- D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.
 - 1. If a section cannot be placed continuously, provide construction joints as indicated.
 - 2. Deposit concrete to avoid segregation.
 - 3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
 - 4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.
 - a. Do not use vibrators to transport concrete inside forms.
 - b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
 - c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
 - d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
- E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

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

3.6 FINISHING FORMED SURFACES

- A. See Section 03 35 00 for requirements.

3.7 FINISHING FLOORS AND SLABS

- A. See Section 03 35 00 for requirements.

3.8 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: See Section 03 35 00 for requirements.
- B. Curbs: See Section 03 35 00 for requirements.
- C. Equipment Bases and Foundations: See Section 03 35 00 for requirements.
- D. Steel Pan Stairs: See Section 033500 for requirements.

3.9 CONCRETE CURING

- A. See Section 033500 for requirements.

3.10 TOLERANCES

- A. Conform to ACI 117.

3.11 APPLICATION OF LIQUID FLOOR TREATMENTS

- A. See Section 033500 for requirements.

3.12 JOINT FILLING

- A. See Section 03 35 00 for requirements.

3.13 CONCRETE SURFACE REPAIRS

- A. Defective Concrete:
 - 1. Repair and patch defective areas when approved by Architect.
 - 2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Unformed Surfaces:
 - 1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.
 - a. Correct low and high areas.
 - b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01-inch-wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 3. After concrete has cured at least 14 days, correct high areas by grinding.
 - 4. Correct localized low areas during, or immediately after, completing surface-finishing operations by cutting out low areas and replacing with patching mortar.
 - a. Finish repaired areas to blend into adjacent concrete.
 - 5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.
 - a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - b. Feather edges to match adjacent floor elevations.
 - 6. Correct other low areas scheduled to remain exposed with repair topping.
 - a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
 - b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
 - 7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.
 - a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
 - b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
 - c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
 - d. Place, compact, and finish to blend with adjacent finished concrete.
 - e. Cure in same manner as adjacent concrete.
 - 8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.
 - a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
 - b. Dampen cleaned concrete surfaces and apply bonding agent.
 - c. Place patching mortar before bonding agent has dried.
 - d. Compact patching mortar and finish to match adjacent concrete.
 - e. Keep patched area continuously moist for at least 72 hours.
- D. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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

3.14 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
 - 1. Testing agency shall be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31.
 - 2. Testing agency shall immediately report to Architect, Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
 - 3. Testing agency shall report results of tests and inspections, in writing, to Owner, Architect, Contractor, and concrete manufacturer within 48 hours of inspections and tests.
 - a. Test reports shall include reporting requirements of ASTM C31, ASTM C39, and ACI 301, including the following as applicable to each test and inspection:
 - 1) Project name.
 - 2) Name of testing agency.
 - 3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
 - 4) Name of concrete manufacturer.
 - 5) Date and time of inspection, sampling, and field testing.
 - 6) Date and time of concrete placement.
 - 7) Location in Work of concrete represented by samples.
 - 8) Date and time sample was obtained.
 - 9) Truck and batch ticket numbers.
 - 10) Design compressive strength at 28 days.
 - 11) Concrete mixture designation, proportions, and materials.
 - 12) Field test results.
 - 13) Information on storage and curing of samples before testing, including curing method and maximum and minimum temperatures during initial curing period.
 - 14) Type of fracture and compressive break strengths at seven days and 28 days.
- B. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size, design air content, design slump at time of batching, and amount of water that can be added at Project site.
- C. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Steel reinforcement welding.
 - 3. Headed bolts and studs.
 - 4. Verification of use of required design mixture.
 - 5. Batch Plant Inspections
 - 6. Concrete placement, including conveying and depositing.
 - 7. Curing procedures and maintenance of curing temperature.
 - 8. Verification of concrete strength before removal of shores and forms from beams and slabs.
- D. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172 shall be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete. Provide one additional set for each additional 100 cu. yd. or fraction thereof or for each 2000 square feet of surface area for wall or slabs.
 - a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 - b. Additional samples for 7-day compressive strength tests shall be taken for each class of concrete at the beginning of the concrete work or whenever the mix or aggregate is changed.
 - c. Provide two additional samples for 56-day compressive strength tests shall be taken for HVFA mixes.
2. Slump: ASTM C143:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
3. Slump Flow for self-consolidating concrete mixes: ASTM C1611:
 - a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - b. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C231 pressure method, for normal-weight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
5. Concrete Temperature: ASTM C1064:
 - a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.
6. Unit Weight: ASTM C567 fresh unit weight of structural lightweight concrete.
 - a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C31:
 - a. Cast and laboratory cure four 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
 - b. Cast and field cure three 6-inch by 12-inch or 4-inch by 8-inch cylinder specimens for each composite sample.
8. Compressive-Strength Tests: ASTM C39/C39M.
 - a. Test one laboratory-cured specimens at 7 days and two specimens at 28 days.
 - b. Retain last specimen if 28 day results are more than 500 psi below specified design strength. Break remaining specimens at time as directed by the Architect.
 - 1) Discard remaining specimen if 28 day results exceed specified design strength.
 - c. Test one field-cured specimens at 7 days and two specimens at 28 days.
 - 1) Hold testing of field cured specimens if results of lab cured 28 day specimens fail to meet specified strength. Break remaining specimens at a time as directed by the Architect.
 - d. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
 - e. When using High Volume Fly Ash (HVFA) concrete mixes, exceeding 25 percent portland cement replacement, conformance with specified design strength shall be measured from cylinder test performed at 14 days and 56 days in lieu of the 7 day and 28 day tests, respectively. All other testing and reporting requirements shall be the same as those for non-HVFA concrete mixes.
9. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

10. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.
 11. Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 72 hours of testing, except as modified below. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 - a. Notify Architect in writing within 24 hours for tests of laboratory cured specimens where 28 day strength results fail to meet specified strength.
 - b. Notify Architect in writing within 24 hours for tests of field cured specimens where 28 day strength results fail to meet 85 percent of specified strength.
 - c. Notify Architect in writing within 24 hours of tests of laboratory cured specimens where 7 day strength results fail to meet 60 percent of specified 28 day strength.
 12. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 13. Additional Tests:
 - a. Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect.
 - b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Architect.
 - 1) Acceptance criteria for concrete strength shall be in accordance with ACI 301 section 1.6.6.3.
 14. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 15. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- E. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 72 hours of completion of floor finishing and promptly report test results to Architect.
- F. Perform shrinkage tests on shrinkage test specimen sets in accordance with ASTM C 157. Length measurements for each specimen shall be recorded at 14, 28, and 35 days after casting. Specimens shall be kept for further testing, if required.

3.15 PROTECTION

- A. Protect concrete surfaces as follows:
1. Protect from petroleum stains.
 2. Diaper hydraulic equipment used over concrete surfaces.
 3. Prohibit vehicles from interior concrete slabs.
 4. Prohibit use of pipe-cutting machinery over concrete surfaces.
 5. Prohibit placement of steel items on concrete surfaces.
 6. Prohibit use of acids or acidic detergents over concrete surfaces.

7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using Floor Slab Protective Covering.

END OF SECTION 03 30 00

SECTION 03 35 11 CONCRETE FLOOR FINISHES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface treatments.
- B. Liquid densifiers and hardeners.
- C. Concrete stains and dyes.
- D. Clear penetrating sealers. SC-1
- E. Slip-resistant coatings.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Finishing of concrete surface to tolerance; floating, troweling, and similar operations; curing.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.
- C. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways.
- D. ASTM C156 - Standard Test Method for Water Loss [from a Mortar Specimen] Through Liquid Membrane-Forming Curing Compounds for Concrete.
- E. ASTM D4039 - Standard Test Method for Reflection Haze of High-Gloss Surfaces.
- F. ASTM D5767 - Standard Test Method for Instrumental Measurement of Distinctness-of-Image (DOI) Gloss of Coated Surfaces.
- G. ASTM F609 - Standard Test Method for Using a Horizontal Pull Slipmeter (HPS).
- H. CBC Ch. 11B - California Building Code-Chapter 11B.
- I. ICRI 310.2R - Selecting and Specifying Concrete Surface Preparation for Sealers, Coatings, Polymer Overlays, and Concrete Repair.
- J. SCAQMD 1113 - Architectural Coatings.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
- B. Coordinate the work with concrete floor placement and concrete floor curing.
- C. Pre-Concrete Placement Meeting:
 - 1. Prior to the start of concrete placement Contractor shall conduct a meeting to review the required methods and procedures to achieve the required finish. Contractor shall send a meeting agenda to all attendees 20 days prior to the scheduled date of the meeting
 - 2. The Contractor shall require responsible representatives of every party concerned with the concreting work to attend the meeting, including but not limited to the following: Contractor's superintendent, ready-mix company, testing lab, topping and coating applicator, and Construction Manager.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's published data on each finishing product, including information on compatibility of different products and limitations.
- C. Manufacturer's Instructions: Indicate manufacturer's installation instructions for preparation of substrate, application of finishing products, and requirements for polishing and protection of finished surface.
- D. Manufacturer's qualification statement.
- E. Installer's qualification statement.
- F. Maintenance Data: Provide data on maintenance and renewal of applied finishes.
- G. Specimen warranty.
- H. Executed warranty.
- I. Certification: Submit manufacturer's certificate that all materials supplied conform to applicable Federal regulations and to applicable State and Local air pollution emission ordinances and regulations.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least 3 years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least 3 years of documented experience.

1.07 MOCK-UPS

- A. For coatings, construct mock-up area under conditions similar to those that will exist during application, with coatings applied.
- B. Construct mock-ups of each exposed concrete floor finish indicated on drawings, 10 feet square.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in manufacturer's sealed packaging, including application instructions.

1.09 FIELD CONDITIONS

- A. Maintain light level equivalent to a minimum 200 W light source at 8 feet above the floor surface over each 20 foot square area of floor being finished.
- B. Do not finish floors until interior heating system is operational.
- C. Maintain ambient temperature of 50 degrees F minimum.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide two-year manufacturer warranty for non-slip commencing on the Date of Final Inspection.

- C. Special Warranty: Provide two-year warranty for adhesion and coverage commencing on the Date of Final Inspection.
- D. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. All products used shall meet VOC requirements listed in Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Requirements for persons with disabilities: Provide flooring meeting slip-resistant requirements of California Code of Regulations (CCR), Title 24, Part 2, CBC Ch. 11B and ADA Standards, latest amendment.
 - 1. Flooring demonstrating a coefficient meeting the intent of slip resistance; CBC Ch. 11B-302 Floor or Ground Surfaces, CBC Ch. 11B-403 Walking Surfaces, and ADA Standards.
 - a. Also acceptable: A dynamic coefficient of friction of at least 0.42 per DCOF AcuTest ANSI A137.1 Section 9.6 or ASTM F609.
 - 2. Flooring surface shall be stable, firm, and slip resistant. CBC Ch. 11B-302.1 General.
 - 3. Flooring surface demonstrating a dynamic coefficient of friction of at least 0.42 wet per DCOF AcuTest ANSI A137.1 Section 9.6 and ANSI/NFSI B101.3 (using a BOT-3000 testing unit) will be accepted as meeting the intent of slip resistance; CBC Ch. 11B-302 Floor or Ground Surfaces and ADA Standards.
 - a. Ramp surface: Provide DCOF value of 0.46 wet.

2.02 APPLICATIONS

- A. Unless otherwise indicated on drawings, finish concrete floors using troweling aid, densifier, and curing agent.
- B. Densifier and Hardener:
 - 1. Use at following locations: concrete floors on grade.
- C. Penetrating Clear Sealer:
 - 1. Use at following locations: SC-1.
- D. Slip-Resistant Coating: Finely-ground aggregates added to coatings.
 - 1. Use at following locations: _____.

2.03 SURFACE TREATMENTS

- A. Troweling Aid, Densifier and Curing Agent: Liquid reactive colloidal silica-based topical treatment, spray-applied to wet concrete and floated or troweled into the surface.
- B. Surface Etching: A water-based liquid or gel compound to remove the concrete surface by chemically etching to produce a certain profile.
 - 1. VOC Compliance: Less than 40 g/L. Conform to SCAQMD 1113 requirements.
 - 2. Concrete Surface Profile: CSP-1 Acid Etched.
 - 3. Products:
 - a. Ameripolish Inc.; EZ Etch-Concrete Surface Etching Agent: www.ameripolish.com.

- b. Eco Safety Products; Ecoprocote-EcoEtch Pro Concrete Etcher & Cleaner:
www.ecosafetyproducts.com.
- c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.04 DENSIFIERS AND HARDENERS

- A. Liquid Densifier and Hardener: Penetrating chemical compound that reacts with concrete, filling the pores, hardening, and dustproofing.
 - 1. Composition: Sodium silicate.
 - a. Products:
 - 1) SC-1 Basis of Design: Curecrete Distribution, Inc; Ashford Formula:
www.curecrete.com/#sle.
 - 2) Euclid Chemical Company; EUCOSIL: www.euclidchemical.com/#sle.
 - 3) L&M Construction Chemicals, Inc; SEAL HARD: www.lmcc.com/#sle.
 - 4) Nox-Crete Inc; Duro-Nox: www.nox-crete.com/#sle.
 - 5) Paul M. Wolff Co.; SHUR-HARD: www.paulwolffco.com.
 - 6) SpecChem, LLC; Cure Hard: www.specchemllc.com/#sle.
 - 7) W. R. Meadows, Inc; Liqui-Hard: www.wrmeadows.com/#sle.
 - 8) Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Composition: Hybrid silicate.
 - a. Products:
 - 1) Ameripolish, Inc; 3D HS Hybrid Silicate Densifier: www.ameripolish.com/#sle.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements.

2.05 COATINGS

- A. Concrete Stain or Dye: Translucent, penetrating compound for interior or exterior use; must be finished with a topical sealer.
 - 1. Number of Coats: Minimum of two.
 - 2. VOC: 100 g/L or less.
 - 3. Application:
 - a. Primary Color: Spray applied.
 - b. Secondary Color: Spray applied.
 - 4. Composition: Water-based, nonreactive.
 - a. Products:
 - 1) Basis of Design: Ameripolish, Inc; Surelock Concrete Dye:
www.ameripolish.com/#sle.
 - 2) BRICKFORM; BRICKFORM ARTesian Stain: www.brickform.com/#sle.
 - 3) Butterfield Color; Elements Transparent Concrete Stain:
www.butterfieldcolor.com.
 - 4) L&M Construction Chemicals, Inc., a subsidiary of Laticrete International, Inc.:
www.lmcc.com.
 - 5) PROSOCO, Inc; GemTone Stain: www.prosoco.com/consolideck/#sle.

- 6) Sika USA; LITHOCHROME Chemstain Classic Concrete Stain: usa.sika.com.
 - 7) Substitutions: See Section 01 60 00 - Product Requirements.
- B. Penetrating Sealer: Transparent, nonyellowing, water-based coating.
1. USDA approved for use with Food and Beverage.
 2. Composition: Hybrid.
 - a. Products:
 - 1) Basis of Design; Curecrete Distribution, Inc; Ashford Formula: www.curecrete.com/#sle.
 - 2) Ameripolish, Inc; 3D SP Concrete Sealer: www.ameripolish.com/#sle.
 - 3) Aqua-Mix; Sealer's Choice Gold: www.custombuildingproducts.com.
 - 4) Glaze N' Seal; Glaze N' Seal Multi-Purpose Sealer : www.glaze-n-seal.com.
 - 5) L&M Construction Chemicals, Inc, a subsidiary of Laticrete International, Inc; L&M Permaguard SPS: www.lmcc.com/#sle.
 - 6) Paul Wolff Co.; Royal-Sheen: www.paulwolff.com
 - 7) Substitutions: See Section 01 60 00 - Product Requirements.
- C. Slip-Resistant Coating:
- D. Plastic Aggregate: Finely ground polymer for addition to coatings for slip resistance.
1. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company; EUCO GRIP: www.euclidchemical.com/#sle.
 - c. SpecChem, LLC; Surface Grip: www.specchemllc.com/#sle.
 - d. W. R. Meadows, Inc; Sure-Step: www.wrmeadows.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that floor surfaces are acceptable to receive the work of this section.
- B. Concrete Substrate: Structurally sound.
- C. Concrete Age: Minimum 28 days old.
- D. Verify that flaws in concrete have been patched and joints filled with methods and materials suitable for further finishes.

3.02 PREPARATION

- A. Blow clean using unoled air or vacuum clean.
- B. Surface profile shall be CSP 2-5 per ICRI 310.2R.

3.03 GENERAL

- A. Apply materials in accordance with manufacturer's instructions.

3.04 CONCRETE FINISHING

- A. Decorative Exposed Surfaces: Trowel as described in ACI PRC-302.1; take measures necessary to avoid black-burnish marks; decorative exposed surfaces include surfaces to be polished, pigmented concrete, surfaces to receive liquid hardeners, and surfaces to receive dry-shake hardeners.
- B. Curing: Water retention 0.0006 psi in accordance with ASTM C156.

3.05 COATING APPLICATION

- A. Verify that surface is free of previous coatings, sealers, curing compounds, water repellents, laitance, efflorescence, fats, oils, grease, wax, soluble salts, residues from cleaning agents, and other impediments to adhesion.
- B. Verify that water vapor emission from concrete and relative humidity in concrete are within limits established by coating manufacturer.
- C. Protect adjacent non-coated areas from drips, overflow, and overspray; immediately remove excess material.
- D. Apply coatings in accordance with manufacturer's instructions, matching approved mock-ups for color, special effects, sealing and workmanship.
- E. Broadcast system:
 - 1. Apply first layer of coating with non-slip aggregate as recommended by manufacturer.
 - 2. Apply topcoat as recommended by manufacturer.

3.06 SURFACE DENSIFIER/SEALER APPLICATION

- A. New Concrete: Apply cure-seal-hardener to new concrete as soon as the concrete is firm enough to work on after troweling; with colored concrete, wait a minimum of 30 days before application.
- B. Existing Concrete: Apply cure-seal-hardener only to clean bare concrete.
 - 1. Thoroughly remove previous treatments, laitance, oil and other contaminants.
 - 2. Saturate surface with cure-seal-hardener; re-spray or broom excess onto dry spots.
 - 3. Keep surface wet with cure-seal-hardener for a minimum soak-in period of 30 - 40 minutes.
 - 4. If most of the material has been absorbed after the 30 minute soak-in period, remove all excess material, especially from low spots, using broom or squeegee.
 - 5. If most of the material remains on the surface after the 30 minute soak-in period, wait until the surface becomes slippery and then flush with water, removing all cure-seal-hardener residue. Squeegee completely dry, flushing any remaining slippery areas until no residue remains.
 - 6. If water is not available, remove residue using squeegee.

3.07 FIELD QUALITY CONTROL

- A. Defective Concrete: Repair or replace concrete not complying with required lines, details, dimensions, tolerances, or specified requirements at no additional cost to District.
- B. Slip Resistance: Minimum 0.43 in accordance with ANSI A326.3 after polishing.
- C. Final Polished Concrete Appearance: Test image clarity value and haze index prior to application of sealer at a rate of three tests per 1000 sq ft of polished concrete.

1. Image clarity: Test with Image Clarity Meter in accordance with ASTM D5767.
2. Haze index: Test with Glossmeter in accordance with ASTM D4039.
3. Match approved mock-ups.

3.08 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.
- B. Protect finished surface as required and as recommended by manufacturer of polishing system until after final inspection.

END OF SECTION

SECTION 04 22 00 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units.
2. Mortar and grout.
3. Steel reinforcing bars.
4. Masonry-joint reinforcement.
5. Miscellaneous masonry accessories.

1.2 DEFINITIONS

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

1.3 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals: In accordance with Section 01 81 13.13 "Sustainable Design Requirements - CALGreen."
- C. Shop Drawings: For the following:
1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.
 2. Reinforcing Steel: Detail bending, lap lengths, and placement of unit masonry reinforcing bars. Comply with ACI 315. Show elevations of reinforced walls.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Material Certificates: For each type and size of the following:
1. Masonry units.
 - a. Include data on material properties.

- b. For masonry units, include data and calculations establishing average net-area compressive strength of units.
 - 2. Cementitious materials. Include name of manufacturer, brand name, and type.
 - 3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
 - 4. Grout mixes. Include description of type and proportions of ingredients.
 - 5. Reinforcing bars.
 - 6. Joint reinforcement.
 - 7. Anchors, ties, and metal accessories.
- C. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
- 1. Include test reports for mortar mixes required to comply with property specification. Test in accordance with ASTM C109/C109M for compressive strength, ASTM C1506 for water retention, and ASTM C91/C91M for air content.
 - 2. Include test reports, in accordance with ASTM C1019, for grout mixes required to comply with compressive strength requirement.
- D. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined in accordance with TMS 602/ACI 530.1/ASCE 6.
- E. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified in accordance with ASTM C1093 for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
- 1. Build mockups at location directed by Architect, in sizes approximately 72 inches long by 72 inches high by full thickness, including face and backup wythes and accessories.
 - 2. Protect accepted mockups from the elements with weather-resistant membrane.
 - 3. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
 - a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
 - b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.
- B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.
- C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.
- D. Deliver preblended, dry mortar mix in moisture-resistant containers. Store preblended, dry mortar mix in delivery containers on elevated platforms in a dry location or in covered weatherproof dispensing silos.
- E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.8 FIELD CONDITIONS

- A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down both sides of walls, and hold cover securely in place.
- B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least three days after building masonry walls or columns.
- C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
 - 1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
 - 2. Protect sills, ledges, and projections from mortar droppings.
 - 3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
 - 4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
- D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.
 - 1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

- E. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in TMS 602/ACI 530.1/ASCE 6.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.
- B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops indicated net-area compressive strengths at 28 days.
 - 1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) in accordance with TMS 602/ACI 530.1/ASCE 6.

2.3 UNIT MASONRY, GENERAL

- A. Masonry Standard: Comply with TMS 602/ACI 530.1/ASCE 6 except as modified by requirements in the Contract Documents.
- B. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated. Do not use units where such defects are exposed in the completed Work.
- C. Fire-Resistance Ratings: Comply with requirements for fire-resistance-rated assembly designs indicated.
 - 1. Where fire-resistance-rated construction is indicated, units are listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction.

2.4 CONCRETE MASONRY UNITS

- A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.
 - 1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
- B. CMUs: ASTM C90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on the drawings.
2. Density Classification: As indicated on Structural drawings.
3. Size (Width): Manufactured to dimensions 3/8 inch less-than-nominal dimensions.

2.5 MASONRY LINTELS

- A. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs matching adjacent CMUs in color, texture, and density classification, with reinforcing bars placed as indicated and filled with coarse grout. Cure precast lintels before handling and installing. Temporarily support built-in-place lintels until cured.
- B. lintels until cured.

2.6 MORTAR AND GROUT MATERIALS

- A. Portland Cement: ASTM C150/C150M, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
 1. Alkali content is not more than 0.1 percent when tested in accordance with ASTM C114.
- B. Hydrated Lime: ASTM C207, Type S.
- C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.
- D. Aggregate for Mortar: ASTM C144.
 1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.
 2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
- E. Aggregate for Grout: ASTM C404.
- F. Water: Potable.

2.7 REINFORCEMENT

- A. Uncoated Steel Reinforcing Bars: ASTM A615/A615M or ASTM A996/A996M, Grade 60.
- B. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells and to hold reinforcing bars in center of cells. Units are formed from 0.148-inch steel wire, hot-dip galvanized after fabrication. Provide units designed for number of bars indicated.
- C. Masonry-Joint Reinforcement, General: Ladder type complying with ASTM A951/A951M.
 1. Interior Walls: Mill- galvanized carbon steel.
 2. Exterior Walls: Hot-dip galvanized carbon steel.
 3. Wire Size for Side Rods: 0.148-inch diameter.

4. Wire Size for Cross Rods: 0.148-inch diameter.
5. Spacing of Cross Rods: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.8 TIES AND ANCHORS

- A. General: Ties and anchors extend at least 1-1/2 inches into masonry but with at least a 5/8-inch cover on outside face.
- B. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:
 1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A82/A82M, with ASTM A153/A153M, Class B-2 coating.
 2. Galvanized-Steel Sheet: ASTM A653/A653M, Commercial Steel, G60 zinc coating.
 3. Steel Sheet, Galvanized after Fabrication: ASTM A1008/A1008M, Commercial Steel, with ASTM A153/A153M, Class B coating.
 4. Steel Plates, Shapes, and Bars: ASTM A36/A36M.
- C. Adjustable Anchors for Connecting to Structural Steel Framing: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
 1. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
 2. Tie Section: Triangular-shaped wire tie made from 0.25-inch- diameter, hot-dip galvanized steel wire.
- D. Partition Top Anchors: 0.105-inch-thick metal plate with a 3/8-inch-diameter metal rod 6 inches long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.
- E. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins unless otherwise indicated.
 1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A153/A153M.

2.9 MISCELLANEOUS MASONRY ACCESSORIES

- A. Compressible Filler: Premolded filler strips complying with ASTM D1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.
- B. Bond-Breaker Strips: Asphalt-saturated felt complying with ASTM D226/D226M, Type I (No. 15 asphalt felt).

2.10 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.
 2. Use Portland cement-lime mortar unless otherwise indicated.
- B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.
- C. Mortar for Unit Masonry: Comply with ASTM C270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.
1. For masonry below grade or in contact with earth, use Type M.
 2. For reinforced masonry, use Type S.
 3. For exterior, above-grade, load-bearing and nonload-bearing walls and parapet walls; for interior load-bearing walls; for interior nonload-bearing partitions; and for other applications where another type is not indicated, use Type S.
- D. Grout for Unit Masonry: Comply with ASTM C476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with TMS 602/ACI 530.1/ASCE 6 for dimensions of grout spaces and pour height.
 2. Proportion grout in accordance with ASTM C476, paragraph 4.2.2 for specified 28-day compressive strength indicated on Structural drawings.
 3. Provide grout with a slump of 8 to 11 inches as measured in accordance with ASTM C143/C143M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
 2. Verify that foundations are within tolerances specified.
 3. Verify that reinforcing dowels are properly placed.
 4. Verify that substrates are free of substances that would impair mortar bond.
- B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Build chases and recesses to accommodate items specified in this and other Sections.
- B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match construction immediately adjacent to opening.

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

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

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

B. Lines and Levels:

- 1. For bed joints and top surfaces of bearing walls, do not vary from level by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
- 2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
- 3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
- 4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2-inch maximum.
- 5. For lines and surfaces, do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2-inch maximum.
- 6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2-inch maximum.
- 7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch.

C. Joints:

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

3.4 LAYING MASONRY WALLS

- A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets.

Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

- B. Bond Pattern for Masonry: Unless otherwise indicated, lay masonry in running bond; do not use units with less-than-nominal 4-inch horizontal face dimensions at corners or jambs.
- C. Stopping and Resuming Work: Stop work by stepping back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.
- D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.
- E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.
- F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below, and rod mortar or grout into core.
- G. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.
- H. Build nonload-bearing interior partitions full height of story to underside of solid floor or roof structure above unless otherwise indicated.
 - 1. Install compressible filler in joint between top of partition and underside of structure above.
 - 2. Fasten partition top anchors to structure above and build into top of partition. Grout cells of CMUs solidly around plastic tubes of anchors and push tubes down into grout to provide 1/2-inch clearance between end of anchor rod and end of tube. Space anchors 48 inches o.c. unless otherwise indicated.
 - 3. At fire-rated partitions, treat joint between top of partition and underside of structure above to comply with Section 07 84 43 "Joint Firestopping."

3.5 MORTAR BEDDING AND JOINTING

- A. Lay hollow CMUs as follows:
 - 1. Bed face shells in mortar and make head joints of depth equal to bed joints.
 - 2. Bed webs in mortar in all courses of piers, columns, and pilasters.
 - 3. Bed webs in mortar in grouted masonry, including starting course on footings.
 - 4. Fully bed entire units, including areas under cells, at starting course on footings where cells are not grouted.
- B. Lay solid CMUs with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.
- C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.
- D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

- E. Cut joints flush where indicated to receive waterproofing unless otherwise indicated.

3.6 MASONRY-JOINT REINFORCEMENT

- A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.
 - 1. Space reinforcement not more than 16 inches o.c.
 - 2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
 - 3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.
- B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.
- C. Provide continuity at wall intersections by using prefabricated T-shaped units.
- D. Provide continuity at corners by using prefabricated L-shaped units.
- E. Cut and bend reinforcing units as directed by manufacturer for continuity at returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

- A. Anchor masonry to structural steel and concrete, where masonry abuts or faces structural steel or concrete, to comply with the following:
 - 1. Provide an open space not less than 1/2 inch wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
 - 2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
 - 3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 CONTROL AND EXPANSION JOINTS

- A. General: Install control- and expansion-joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.
- B. Form control joints in concrete masonry as follows:
 - 1. Fit bond-breaker strips into hollow contour in ends of CMUs on one side of control joint. Fill resultant core with grout, and rake out joints in exposed faces for application of sealant.

3.9 LINTELS

- A. Provide masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

- B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.10 REINFORCED UNIT MASONRY

- A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.
 - 1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
 - 2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.
- B. Placing Reinforcement: Comply with requirements in TMS 602/ACI 530.1/ASCE 6.
- C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
 - 1. Comply with requirements in TMS 602/ACI 530.1/ASCE 6 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
 - 2. Provide grout pour height in accordance with CBC 2104A.1.3.5. and 2104A.1.3.6.
 - 3. Provide high-lift grout in accordance with DSA IR 21-2.
- D. High Lift Grouting: Where vertical grout pours will be greater than 60", the following requirements will be followed:
 - 1. Comply with the requirements of DSA IR 21-2 and CBC 2104A.1.3.1.1.2.
 - 2. Cleanouts shall be provided for each pour by leaving out every other unit in the bottom tier of the section be poured or by cleanout openings in the foundation. The foundation or other horizontal construction joints shall be cleaned of all loose material and mortar droppings before each pour. The cleanouts shall be sealed after inspection and before grouting.
 - 3. The clear width of grout space shall be a minimum of 3-1/2" inches. All reinforcement and wire ties shall be embedded in grout. The thickness of the grout between masonry units and reinforcement shall be a minimum of one bar diameter.
 - 4. Vertical grout barriers or dams of solid masonry shall be built across the grout space the entire height of the wall to control the flow of grout horizontally. Grout barriers shall be spaced not more than 30 feet apart.
 - 5. An approved admixture of a type that reduces early water loss and produces an expansion actions shall be used.
 - 6. Grouting shall be done in continuous pour lifts not exceeding 4 feet. Grout shall be consolidated by mechanical vibration only, and shall be reconsolidated after excess moisture has been absorbed, but before plasticity is lost. The grouting of a wall between control barriers shall be completed in one day, with no interruptions greater than one hour.

3.11 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to

perform tests and inspections. Retesting of materials that fail to comply with specified requirements is done at Contractor's expense.

- B. Inspections: Special inspections in accordance with Level B in TMS 402/ACI 530/ASCE 5.
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
 - 2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 - 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
- D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.
- E. Concrete Masonry Unit Test: For each type of unit provided, in accordance with ASTM C140 for compressive strength.
- F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, in accordance with ASTM C780.
- G. Mortar Test (Property Specification): For each mix provided, in accordance with ASTM C780. Test mortar for mortar air content and compressive strength.
- H. Grout Test (Compressive Strength): For each mix provided, in accordance with ASTM C1019.
- I. Prism Test: For each type of construction provided, in accordance with ASTM C1314 at 28 days.

3.12 REPAIRING, POINTING, AND CLEANING

- A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.
- B. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.
- C. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
 - 1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
 - 2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
 - 3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
 - 4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
 - 5. Clean concrete masonry by applicable cleaning methods indicated in NCMA TEK 8-4A.

3.13 MASONRY WASTE DISPOSAL

- A. Salvageable Materials: Unless otherwise indicated, excess masonry materials are Contractor's property. At completion of unit masonry work, remove from Project site.
- B. Masonry Waste Recycling: Return broken CMUs not used as fill to manufacturer for recycling.
- C. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above or recycled, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 22 00

SECTION 05 12 00 - STRUCTURAL STEEL

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. Structural steel.
 - 2. Field-installed shear connectors.
 - 3. Non-shrink Grout.
- B. Related Requirements:
 - 1. Section 05 50 00 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
 - 2. Section 09 91 23 "Interior Painting" for surface-preparation and priming requirements.

1.3 DEFINITIONS

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

1.4 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

- A. Pre-installation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

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

- B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 2. Include embedment Drawings.
 3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
- C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1, "Structural Welding Code - Steel," for each welded joint whether prequalified or qualified by testing, including the following:
1. Power source (constant current or constant voltage).
 2. Electrode manufacturer and trade name, for demand critical welds.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and fabricator.
1. Fabricator Qualifications: Reference section 1.8A, "Quality Assurance".
 - a. AISC Quality Certification Program: Submit documentation with initial shop drawing submittal as follows:
 - 1) Copy of AISC Certification Certificate.
 - b. In-Plant Special Inspections: Submit documentation with initial shop drawing submittal as follows:
 - 1) Name of special inspection agency and personnel performing inspections.
 - 2) Name and qualifications of "Engineer of Record" for In-Plant Special Inspections responsible for review and submission of final signed and sealed inspection report.
 - 3) Distribution list for inspection reports.
 2. Installer Qualifications: Reference section 1.8B, "Quality Assurance".
 - a. AISC Quality Certification Program: Submit documentation with initial shop drawing submittal as follows:
 - 1) Copy of AISC Certification Certificate.
 - 2) Documentation that erector has completed a minimum of (5) projects of similar size and scope.
- B. Welding certificates.
- C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
- D. Product Test Reports: For the following:
1. Non-shrink grout.
- E. Survey of existing conditions.
- F. Field quality-control and special inspection reports.
- G. Erection plan sequence and procedures.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU at time of bid,

-or-

Special Inspection shall be conducted on the premises of the steel fabricator in accordance with 1704A.2.5 of the CBC.

- B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE at time of bid.

-or-

The installer has experience completing a minimum of (5) projects of similar in scope and scale.

- C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or to SSPC-QP 3, "Standard Procedure for Evaluating Qualifications of Shop Painting Applicators."

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

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

- E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use Load and Resistance Factor Design; data are given at factored-load level.

2.2 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A 992.
- B. Channels, Angles, M, S-Shapes: ASTM A 36/ Materials complying with first option in "Plate and Bar" Paragraph below are widely available; those complying with second option are less so. Third option is a specialty-steel material; verify availability if required.
- C. Plate and Bar: ASTM A 36
- D. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.
- E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A 490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A 563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F 959, Type 490, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip or mechanically deposited zinc coating.
 - 2. Direct-Tension Indicators: ASTM F 959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.

- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Mechanically deposited zinc coating.
- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- F. Unheaded Anchor Rods: ASTM F 1554, Grade 36 or As Indicated.
 - 1. Configuration: Straight.
 - 2. Nuts: ASTM A 563 hex carbon steel.
 - 3. Plate Washers: ASTM A 36 carbon steel.
 - 4. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 5. Finish: Hot-dip zinc coating, ASTM A 153, Class C or Mechanically deposited zinc coating, ASTM B 695, Class 50.
- G. Headed Anchor Rods: ASTM F 1554, Grade 36 or As Indicated straight.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Plate Washers: ASTM A 36 carbon steel.
 - 3. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 4. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C or Mechanically deposited zinc coating, ASTM B 695, Class 50.
- H. Threaded Rods: ASTM A 36/A 36M or As Indicated.
 - 1. Nuts: ASTM A 563 hex carbon steel.
 - 2. Washers: ASTM F 436, Type 1, hardened carbon steel.
 - 3. Finish: Hot-dip zinc coating, ASTM A 153/A 153M, Class C or Mechanically deposited zinc coating, ASTM B 695, Class 50.
- I. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.
- J. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.
- K. Sleeve Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1018.
- L. Structural Slide Bearings: Low-friction assemblies, of configuration indicated, that provide vertical transfer of loads and allow horizontal movement perpendicular to plane of expansion joint while resisting movement within plane of expansion joint.
 - 1. Mating Surfaces: PTFE and PTFE.
 - 2. Coefficient of Friction: Not more than 0.06.
 - 3. Design Load: Not less than 5,000 psi.
 - 4. Total Movement Capability: 2 inches.

2.4 PRIMER

- A. Shop Primers: Comply with Section 09 91 23 "Interior Painting," and Section 09 96 00 "High-Performance Coatings."

- B. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.5 GROUT

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

2.6 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360.
 - 1. Camber structural-steel members where indicated.
 - 2. Fabricate beams with rolling camber up.
 - 3. Identify high-strength structural steel according to ASTM A 6 and maintain markings until structural steel has been erected.
 - 4. Mark and match-mark materials for field assembly.
 - 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
 - 1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "Solvent Cleaning."
- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 - 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 - 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 - 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.7 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pretensioned or Slip critical As Indicated.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.8 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 - 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 - 2. Surfaces to be field welded.
 - 3. Surfaces of high-strength bolted, slip-critical connections.
 - 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 - 5. Galvanized surfaces.
- B. Preparation for Shop Priming: Clean surfaces to be painted per primer manufacturer's written instructions. Remove loose rust and mill scale and other spatter, slag, flux deposits, and any other potential bond-breaking materials.
- C. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
 - 1. SSPC-SP 2, "Hand Tool Cleaning."
 - 2. SSPC-SP 3, "Power Tool Cleaning."
 - 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 - 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
 - 5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
 - 6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
 - 7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
 - 8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
 - 9. SSPC-SP 8, "Pickling."
- D. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.
 - 1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
 - 2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.
- E. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.9 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.
 - 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 - 2. Galvanize lintels, shelf angles and welded door frames attached to structural-steel frame and located in exterior walls.

2.10 SOURCE QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
- B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1. Liquid Penetrant Inspection: ASTM E 165.
 - 2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3. Ultrasonic Inspection: ASTM E 164.
 - 4. Radiographic Inspection: ASTM E 94.
- D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - 2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
 - 1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

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

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.
 - 1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.
- B. Baseplates, Bearing Plates and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

- H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, Pre-tensioned or Slip Critical, as indicated.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:
 - 1. Verify structural-steel materials and inspect steel frame joint details.
 - 2. Verify weld materials and inspect welds.
 - 3. Verify connection materials and inspect high-strength bolted connections.
- B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts."
- D. Welded Connections: Visually inspect field welds according to AWS D1.1.
 - 1. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
- E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - 1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.

2. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
- C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 96 00 High Performance Coatings" and Section 09 91 23 "Interior Painting."
- D. Touchup Priming: Cleaning and touchup priming are specified in Section 09 96 00 "High-Performance Coatings."

END OF SECTION 05 12 00

SECTION 05 50 00 METAL FABRICATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop fabricated steel items.
- B. Requirements for materials and equipment for post-installed mechanical and adhesive anchors in concrete.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of metal fabrications in concrete.
- B. Section 05 12 00 - Structural Steel Framing: Structural steel column anchor bolts.
- C. Section 05 51 33 - Metal Ladders.
- D. Section 09 91 13 - Exterior Painting: Paint finish.
- E. Divisions 10 - Specialties, 22 - Plumbing, 26 - Electrical, 27 - Communications, and 28 - Electronic Safety and Security: Mounting of equipment and components.

1.03 REFERENCE STANDARDS

- A. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- B. ACI 355.4 - Qualification of Post-Installed Adhesive Anchors in Concrete; Current adopted edition.
- C. ACI 440.2R - Guide for the Design and Construction of Externally Bonded FRP Systems for Strengthening Concrete Structures; 2017.
- D. AISC 201 - AISC Certification Program for Structural Steel Fabricators, Standard for Steel Building Structures; 2006.
- E. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications; 2023.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- G. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- H. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- I. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- J. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- K. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- L. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- M. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2023.

- N. ASTM E329 - Standard Specification for Agencies Engaged in Construction Inspection, Testing, or Special Inspection; 2023.
- O. ASTM E488/E488M - Standard Test Methods for Strength of Anchors in Concrete Elements; 2022.
- P. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.
- Q. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- R. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- T. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).
- U. DSA IR 17-11 - Identification, Sampling and Testing of Threaded Steel Anchor Bolts and Anchor Rods; Current Adopted Edition.
- V. DSA IR 22-2 - Anchor Rods (Bolts) Connecting Steel to Concrete; Current Adopted Edition.
- W. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- X. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.
- Y. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.
- Z. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.
- AA. SSPC-SP 5 - White Metal Blast Cleaning; 2007.
- BB. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- CC. SSPC-SP 10 - Near-White Metal Wet Abrasive Blast Cleaning; 2015.
- DD. SSPC-SP 2 - Hand Tool Cleaning; 2018.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. ICC ES Reports: If requested, ICC Evaluation Service report indicating conformance with ICC-ES Acceptance Criteria.
- C. Shop Drawings: Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- D. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- E. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172, AISC 201, or City of Los Angeles Certified Fabricator.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172, AISC 201, or City of Los Angeles Certified Fabricator.
- C. Testing Agency Qualifications: An independent agency qualified according to ASTM E329 and Section 01 45 33 for testing indicated.

1. Special Inspector: AWS-CWI qualified inspector approved by DSA for all welding.
- D. Installer Training: Prior to beginning the work, manufacturer or manufacturer's representative shall provide on-site training for all contractor's personnel who will be installing anchors.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Conform to applicable requirements of California Building Code (CBC), Title 24, Part 2, as amended and adopted by authorities having jurisdiction.
 1. Comply with Title 24, Part 9, California Fire Code Chapter 35 "Welding and Other Hot Work."

2.02 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M, for channels, angles and plates.
- B. Steel Tubing: ASTM A500/A500M Grade B cold-formed structural tubing.
- C. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- D. Slotted Channel Framing: ASTM A653/A653M, Grade 33.
- E. Slotted Channel Fittings: ASTM A1011/A1011M.
- F. Mechanical Fasteners: Same material as or compatible with materials being fastened; type consistent with design and specified quality level.
- G. Bolts, Nuts, and Washers: As indicated on Drawings.
- H. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- I. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.
 1. Comply with SSPC-PA 1. Coordinate with requirements specified in Section 09 91 13 - Exterior Painting and 09 96 00 - High-Performance Coatings .
 - a. Coordinate primer with finish paint and coating, as applicable, to provide sound foundation for field-applied topcoats despite prolonged exposure during construction.
 - 1) Shop primer for ferrous metal at exposed exterior locations: Tnemec 90E-92, ethyl silicate zinc primer, or equal.
 - b. Apply primer immediately following surface preparation.
- J. Galvanize all exterior steel members to comply with ASTM A123/A123M. Provide minimum 1.7 oz/sq ft galvanized coating.
- K. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.

2.03 FABRICATION

- A. Ferrous Metal Surfaces, General:
 1. For metal fabrications exposed to view upon completion of the Work: Provide ferrous metals materials selected for their surface flatness, smoothness, and freedom from surface blemishes.
 2. Do not use materials whose exposed surfaces exhibit pitting, seam marks, roller marks, rolled trade names, roughness, and, for steel sheet, variations in flatness exceeding those permitted by reference standards for stretcher-leveled sheet.

- B. Hot-dip galvanize fabricated ferrous items, indicated as remaining unpainted, after fabrication. Field connections shall be bolted or screwed where possible. Avoid field cutting and welding which damage galvanized coating.
- C. Fit and shop assemble items in largest practical sections, for delivery to site.
- D. Fabricate items with joints tightly fitted and secured.
- E. Gas cutting of non-structural steel items may be acceptable where stress is not transmitted through flame-cut surfaces.
 - 1. Make cuts clean and to contour.
 - 2. Deduct 1/8 inch from effective width of members cut by torch.
- F. Continuously seal joined members by intermittent welds and plastic filler.
- G. Joints Exposed to Weather or Water: Fabricate to keep water out, or provide adequate drainage of water that penetrates.
- H. Steel Tubing and Piping Fabrication: Unless otherwise indicated, close ends with plate stock so no exposed ends of tubing and piping. Grind all edges.
- I. Connections, General:
 - 1. Component parts of built-up members shall be well-pinned with closely-fitted contact.
 - 2. Conceal connections where possible.
 - 3. Otherwise, make countersinks for concealment after fabrication, except where noted.
- J. Welding: Conform to AWS D1.1/D1.1M recommendations.
 - 1. Do not field weld galvanized components to remain unfinished.
 - 2. Provide continuous welds at welded corners and seams.
 - 3. Grind exposed welds smooth and flush with base material.
 - 4. Re-weld to fill holes. Putties and fillers are not acceptable.
- K. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- L. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
 - 1. Bolted and Screwed Connections:
 - a. Provide holes and connections for work specified in other Sections.
 - b. Use bolts for field connections only.
 - c. Provide washers under heads and nuts bearing on wood.
 - d. Draw all nuts tight and nick threads of permanent connections.
 - e. Use beveled washers where bearing is on sloped surfaces.
 - f. Where screws must be used for permanent connections in ferrous metal, use flat head type, countersunk, with screw slots filled and finished smooth and flush.
- M. Furnish components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 FABRICATED ITEMS

- A. Rough Hardware
 - 1. Provide bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as indicated on Drawings.

B. Other Products and Fabrications

1. Other Products and Fabrications: Provide all materials not specifically described but required for a complete and proper installation, as selected by the Contractor, subject to review and acceptance by Construction Manager and Architect.

C. Slotted Channel Framing: Fabricate channels and fittings from structural steel complying with the referenced standards; electro-galvanized per ASTM B633 Type III, SC 1 finish.

D. Plumbing Security Cage:

1. Basis of Design: Sentry Maximum Security Cage as manufactured by D&M Manufacturing, Inc. (www.backflowtheft.com); or equal.
2. Placer Waterworks: placerwaterworks.com
3. Substitutions: See Section 01 60 00 - Product Requirements.
4. Components:
 - a. 3/16 inch Welded Angle Iron Frame.
 - b. High Security 3/4 inch Steel Pin Hinges.
 - c. 9 Gauge Diamond Mesh.
 - d. Zinc Primed.
 - e. Finish: Powder Coated.
 - f. Security Closure Blocks
 - g. Lock Guard.
 - h. Epoxy ready frame.

2.05 POST INSTALLED CONCRETE ANCHORS

A. Manufacturers:

1. Manufacturers: Provide products as indicated on the approved Structural Drawings.
2. Substitutions: Substitutions of products from manufacturer's not listed are not permitted.
 - a. Substitution of structural anchors requires structural calculations and DSA approval.

B. Materials:

1. Conform to Code Evaluation Report, ACI 355.4, DSA IR 17-11, and DSA IR 22-2.
2. Interior Use: For use in conditioned environments free from potential moisture, provide zinc plated carbon steel anchors.
3. Exterior Use:
 - a. In exposed or potentially wet environments, and for attachment of exterior cladding materials, provide stainless steel anchors.
 - b. Stainless steel nuts and washers shall be of matching alloy group of equal or greater strength than the rod.
 - c. Avoid installing stainless steel anchors in contact with galvanically dissimilar metals.
4. Deformed Reinforcing Bars: Deformed steel rebar conforming to ASTM A615/A615M Grade 60. Permissible sizes as described in each adhesive products ICC report.

C. Mechanical Anchors:

1. Expansion, screw or undercut anchors having current ICC approval for use in cracked and uncracked concrete, with a published ICC Evaluation Service report.
 - a. Type and size as indicated on drawings.

2. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
 3. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:
- D. Adhesive Anchors:
1. Cartridge Injection Adhesive Anchors: Threaded carbon steel rod, inserts, or reinforcing dowels complete with required nuts, washers, adhesive system and manufacturer's installation instructions.
 - a. Type and size as indicated on drawings.
 - b. Current ICC approval for use in cracked and uncracked concrete with a published ICC Evaluation Service report required.
 2. Interior Use: Unless otherwise indicated on the Drawings, provide:
 - a. Carbon steel threaded rods conforming to specification as indicated on structural drawings. Where no specification and grade are indicated, provide: ASTM A193/A193M Type B7 with zinc plating in accordance with ASTM B633, Type III Fe/Zn 5 (SC1).
 3. Exterior Use: As indicated on the Drawings, provide stainless steel anchors.
 - a. Stainless steel anchors shall be AISI Type 304 and Type 316 stainless steel provided with stainless steel nuts and washers of matching alloy group and minimum proof stress equal to or greater than the specified minimum full-size tensile strength of the externally threaded fastener.
 - b. All nuts shall conform to ASTM F594, unless otherwise specified.
 4. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to concrete are as indicated on Drawings:
 5. Basis of Design Approved Products conforming to this specification are acceptable for anchoring to grouted masonry are as indicated on Drawings:
- E. Power-Driven/Powder Actuated Fasteners
1. Use only if approved by Architect, generally not permitted where not specifically indicated or in load-bearing installations; as indicated on Drawings.

2.06 FINISHES - STEEL

- A. Mechanical Finishes: Complete finishing prior to fabrication wherever possible.
1. After fabrication, finish all joints, bends, abrasions, and other surface blemishes to match finish.
 2. Protect finish on exposed surfaces by using temporary protective covering.
- B. Prime paint steel items.
1. Exceptions: Galvanize items to be embedded in concrete.
 2. Exceptions: Do not prime surfaces in direct contact with concrete, where field welding is required, and items to be covered with sprayed fireproofing.
- C. Prepare surfaces to be primed in accordance with SSPC-SP2.
1. Exterior fabrications: Clean in accordance with SSPC-SP 5, SSPC-SP 6, 8, or SSPC-SP 10.
- D. Clean surfaces of rust, scale, grease, and foreign matter prior to finishing.
- E. Prime Painting: One coat.

- F. Galvanizing of Structural Steel Members: Galvanize all exterior steel members after fabrication to ASTM A123/A123M requirements. Provide minimum 1.7 oz/sq ft galvanized coating.
- G. Galvanizing of Non-structural Items: Galvanize all exterior steel members after fabrication to ASTM A123/A123M requirements.

2.07 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.
- F. Punch, drill and reaming in manner to leave clean, true lines and surfaces.
 - 1. Oversize hole 1/16 inch by punching, when material thickness is equal to or less than bolt diameter plus 1/8 inch.
 - 2. Sub-punch 1/16 inch smaller than bolt and drill or ream to oversize by 1/16 inch, when material thickness is thicker than bolt diameter plus 1/8 inch.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Field Inspection of Fabricated Products: Prior to installation, inspect products for damage and verify markings and dimensions against reviewed submittals.
- C. Environmental Conditions: Do not install products intended for interior locations when spaces are uncovered and unprotected from inclement weather.
- D. Coordination: Coordinate metal fabrications Work with Work specified in other Sections so that related Work shall be accurately and properly joined.
- E. Post Installed Anchors
 - 1. Verification of Conditions
 - a. Base Material Strength: Unless otherwise specified, do not drill holes in concrete until concrete has achieved full design strength.
 - b. Temperature of concrete surface and ambient air temperature must meet manufacturer's requirements prior to use of adhesive anchor products.
 - c. Embedded Items:
 - 1) Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors.
 - 2) Exercise care in coring or drilling to avoid damaging existing reinforcing or embedded items.
 - 3) Take precautions as necessary to avoid damaging anything embedded in the concrete including electrical/telecommunications conduit, gas pipes, and plumbing pipes.
 - 4) Notify the Architect if reinforcing steel or other embedded items are encountered during drilling.

- d. Beginning of installation indicates acceptance of existing conditions.

3.02 PREPARATION

- A. Clean and strip primed steel items to bare metal where site welding is required.
- B. Supply setting templates to the appropriate entities for steel items required to be cast into concrete.
- C. Make provision for erection loads with temporary bracing. Keep work in alignment.
- D. Obtain Architect's review prior to site cutting or making adjustments not indicated on Drawings and reviewed shop drawings.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.
- F. After erection, prime welds, abrasions, and surfaces not shop primed , except surfaces to be in contact with concrete.
 - 1. Touch up galvanized steel with cold galvanizing compound.

3.04 INSTALLATION OF POST-INSTALLED ANCHORS

- A. Installation shall comply with all manufacturer's instructions and current ICC ESR report.
- B. Post-Installed Anchors in Hardened Concrete.
 - 1. Drilled-in anchors and/or powder driven pins in existing non-prestressed reinforced concrete: use care and caution to avoid cutting or damaging the existing reinforcing bars.
 - 2. Maintain a minimum clearance of one inch between the reinforcement and the drilled-in anchor and/or pin.
- C. Manufacturer shall provide on-site training for all personnel who will be installing post-installed adhesive anchors at the beginning of the work. Installation of anchors must be performed by a certified installer.
- D. Where manufacturer recommends use of special tools for installation of anchors, such tools shall be used, unless otherwise permitted specifically by the Engineer.
- E. Drill holes with rotary impact hammer drills using carbide-tipped bits. Bits must be of type required and permitted by ICC ESR report.
 - 1. Drill holes with rotary impact hammer drills using carbide-tipped bits or core drills using diamond core bits.
 - 2. Drill bits shall be of diameters as specified by the anchor manufacturer.
 - 3. Unless otherwise shown on the Drawings, all holes shall be drilled perpendicular to the concrete surface.
 - 4. Where anchors are to be installed in cored holes, use core bits with matched tolerances as specified by the manufacturer.
 - 5. Cored holes may only be used if acceptable to the Engineer and in compliance with ICC ESR report.
- F. Holes shall be cleared of debris after holes are drilled per manufacturer's instructions.

1. For adhesive installations, at a minimum, holes shall be blown out with oil-free compressed air and shall be brushed with a wire or nylon brush.
 2. Holes shall than be blown out one additional time with oil-free compressed air.
 3. Additional hole cleaning requirements may be required by manufacturer and ICC ESR Report.
- G. During adhesive curing time period, the temperature of the substrate shall be kept above the minimum substrate temperature as defined by the manufacturer. Contractor shall determine the appropriate means and methods to ensure that the temperature is kept above the required minimum temperature required before adhesive installation is begun.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

3.06 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 45 33 - Code-Required Special Inspections.
 1. Special Inspector: AWS-CWI qualified inspector to inspect all welds.
- B. Inspection: Special inspection of post-installed anchors shall be provided as required by the ICC-ES report for that anchor and not less than the requirements of the Structural Drawings and the following (whichever is the most restrictive):
 1. Continuously observe the installation of all anchors, or as specified in the ICC report.
 - a. Minimum anchor embedments, proof loads and torques shall be as shown on the Drawings.
 - b. Load Testing: Per Structural General Notes on Drawings.
 - c. Post-Installed Anchor Load Testing: CBC Section 1910A.5.
 - 1) As indicated on Structural Drawings, minimum 10 % of drilled-in sill plate bolting anchor applications shall be proof loaded by the independent testing laboratory.
 - 2) 100 % of each type and size of drilled-in anchor shall be proof loaded by the independent testing laboratory.
 - 3) Adhesive anchors and capsule anchors shall not be torque tested unless otherwise directed by the Architect.
 - 4) Tension testing should be performed in accordance with ASTM E488/E488M.
 - 5) Torque shall be applied with a calibrated torque wrench.
 - 6) Proof loads shall be applied with a calibrated hydraulic ram, as required and indicated on the Structural Drawings. Comply with CBC 1910A.5.
 - (a) Displacement of adhesive and capsule anchors at proof load shall not exceed $D/10$, where D is the nominal anchor diameter.
 - 7) If any of the tested anchors fail to achieve the specified torque or proof load within the limits as defined on the Drawings, all anchors of the same diameter and type as the failed anchor shall be tested, unless otherwise instructed by the Architect.

- d. Verify anchor type, anchor dimensions, hole dimensions, anchor spacing, edge distances, anchor embedment and adherence to the manufacturer's published installation instructions.
 - e. For adhesive anchors also verify hole cleaning technique, adhesive expiration date and proper mixing and dispensing.
 - 2. Subsequent inspection of installation will be required when there is a change of personnel doing the installation. Change is defined as any one or more persons drilling or preparing holes, or installing anchors.
 - 3. Visually inspect 100% of all installed anchors.
- C. Reporting:
 - 1. Daily reports shall reference the applicable ICC-ES report number, indicate that all specified criteria were complied with and provide itemized verification of all inspected items.
 - 2. Special Inspector shall immediately report any deviations from the requirements to the Architect.
- D. Defective Work:
 - 1. Installations that are not accepted by the Special Inspector shall be considered defective.
 - 2. Provide additional testing and inspection to determine acceptability of defective work, as directed by the Architect at Contractor's expense.

3.07 REPAIR OF DEFECTIVE WORK

- A. Remove and replace misplaced, defective or malfunctioning anchors at Contractor's expense. Replacement of anchors requires signed structural detail, unless otherwise noted.
- B. Fill empty anchor holes and patch failed anchor locations with high-strength, non-shrink non-metallic grout.

END OF SECTION

SECTION 05 51 33 METAL LADDERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Shop-fabricated metal ladders.
- B. Prefabricated ladders.

1.02 RELATED REQUIREMENTS

- A. Section 05 52 13 - Pipe and Tube Railings.
- B. Section 09 91 13 - Exterior Painting: Paint finish.
- C. Section 09 91 23 - Interior Painting: Paint finish.
- D. Section 11 81 29 - Facility Fall Protection: Ladder safety systems.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.27 - Scaffolds and Rope Descent Systems; Current Edition.
- B. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- C. ANSI A14.3 - American National Standard for Ladders -- Fixed -- Safety Requirements; 2008 (Reaffirmed 2018).
- D. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- E. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- F. ASTM A283/A283M - Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates; 2018.
- G. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- H. ASTM A501/A501M - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing; 2021.
- I. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings; 2018, with Editorial Revision.
- J. ASTM B85/B85M - Standard Specification for Aluminum-Alloy Die Castings; 2018, with Editorial Revision.
- K. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- L. ASTM B210/B210M - Standard Specification for Aluminum and Aluminum-Alloy Drawn Seamless Tubes; 2019a.
- M. ASTM B211/B211M - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire; 2019.
- N. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- O. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- P. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- Q. AWS D1.2/D1.2M - Structural Welding Code - Aluminum; 2014, with Errata (2020).

- R. IAS AC172 - Accreditation Criteria for Fabricator Inspection Programs for Structural Steel AC172; 2019.
- S. SSPC-Paint 15 - Steel Joist Shop Primer/Metal Building Primer; 2004.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details where applicable.
 - 2. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- D. Fabricator's Qualification Statement: Provide documentation showing steel fabricator is accredited under IAS AC172.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and AWS D1.2/D1.2M and dated no more than 12 months before start of scheduled welding work.
- B. Fabricator Qualifications: A qualified steel fabricator that is accredited by IAS AC172.

PART 2 PRODUCTS

2.01 MATERIALS - STEEL

- A. Steel Sections: ASTM A36/A36M.
- B. Steel Tubing: ASTM A501/A501M hot-formed structural tubing.
- C. Plates: ASTM A283/A283M.
- D. Pipe: ASTM A53/A53M, Grade B Schedule 40, black finish.
- E. Mechanical Fasteners: Same material or compatible with materials being fastened; type consistent with design and specified quality level.
- F. Bolts, Nuts, and Washers: ASTM A307, plain.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Shop and Touch-Up Primer: SSPC-Paint 15, complying with VOC limitations of authorities having jurisdiction.

2.02 MATERIALS - ALUMINUM

- A. Extruded Aluminum: ASTM B211/B211M, 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209/B209M, 5052 alloy, H32 or H22 temper.
- C. Aluminum-Alloy Drawn Seamless Tubes: ASTM B210/B210M, 6063 alloy, T6 temper.
- D. Aluminum-Alloy Bars: ASTM B211/B211M, 6061 alloy, T6 temper.
- E. Aluminum-Alloy Sand Castings: ASTM B26/B26M.
- F. Aluminum-Alloy Die Castings: ASTM B85/B85M .

- G. Bolts, Nuts, and Washers: Stainless steel.
- H. Welding Materials: AWS D1.2/D1.2M; type required for materials being welded.

2.03 FABRICATION

- A. Fit and shop assemble items in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component, except where specifically noted otherwise.
- E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.04 PREFABRICATED LADDERS

- A. Provide roof access ladder and cage where required, as indicated on Drawings, fabricated of bar/rail sides and brackets, mounted to building wall, configured and dimensioned in conformance to OSHA Regulation 29 CFR 1910.27.
 - 1. Unless otherwise shown or required by governing authorities, fabricate ladder in accordance with NAAMM standards and recommended details.
- B. Prefabricated Ladder: Welded metal unit complying with ANSI A14.3; factory fabricated to greatest degree practical and in the largest components possible.
 - 1. Components: Manufacturer's standard rails, rungs, treads, handrails, returns, platforms and safety devices complying with the requirements of the MATERIALS article of this section.
 - 2. Materials: Aluminum; ASTM B211/B211M 6063 alloy, T52 temper.
 - 3. Finish: Manufacturer's standard clear anodized coating, comply with AAMA 611, Class 1.
 - 4. Rungs: Not less than 1-1/4 inches (32 mm) in section and 18-3/8 inches (467mm) long, formed from tubular aluminum extrusions. Squared and deeply serrated on all sides.
 - a. Rungs shall withstand a 1,500 pound (454 kg) load without deformation or failure.
 - 5. Channel Side Rails: Not less than 1/8 inch (3 mm) wall thickness by 3 inches (76 mm) wide.
 - 6. Heavy Duty Tubular Side Rails: Assembled from two interlocking aluminum extrusions no less than 1/8 inch (3 mm) wall thickness by 3 inches (76 mm) wide. Construction shall be self-locking stainless steel fasteners, full penetration TIG welds and clean, smooth and burr-free surfaces.
 - 7. Fixed and Cage Ladder:
 - a. Safety cages are required on ladders over 20 feet.
 - b. Safety cages are required on all ladders in high or hazardous areas.
 - c. Fabricate ladder safety cages to comply with authority having jurisdiction. Assemble by welding. Spacing of primary hoops, secondary hoops and vertical bars shall not exceed that required by code.
 - d. Safety cage hoops and vertical bars: 3/16 inch (5 mm) by 2 inches (51 mm) aluminum bar.

8. Walk-Through Rail and Roof Rail Extension: Not less than 3 feet 6 inches (1067 mm) above the landing and shall be fitted with deeply serrated, square, tubular grab rails.
9. Landing Platform: 1-1/2 inches (38 mm) or greater diameter, tubular aluminum guardrails and decks of serrated aluminum treads.
10. Security Doors: Formed 1/8 inch (3 mm) thick aluminum sheet.
 - a. Extend security panels on both sides, perpendicular to the door face, to within 2 inches (51 mm) of the wall.
 - b. Furnish security door continuous aluminum piano hinge and heavy duty forged steel locking hasps.
 - 1) Padlock, OFOI by District.
11. Manufacturers:
 - a. O'Keeffe's Inc; Model 500: www.okeeffes.com/#sle.
 - b. Precision Ladders, LLC; Fixed Aluminium Wall Ladder: www.precisionladders.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 FINISHES - ALUMINUM

- A. Exterior Aluminum Surfaces: Class I natural anodized.
- B. Interior Aluminum Surfaces: Class I natural anodized.
- C. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

2.06 FABRICATION TOLERANCES

- A. Squareness: 1/8 inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces: 1/16 inch.
- C. Maximum Misalignment of Adjacent Members: 1/16 inch.
- D. Maximum Bow: 1/8 inch in 48 inches.
- E. Maximum Deviation From Plane: 1/16 inch in 48 inches.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.

3.02 PREPARATION

- A. Clean and strip aluminum where site welding is required.

3.03 INSTALLATION

- A. Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- C. Field weld components as indicated on drawings.
- D. Perform field welding in accordance with AWS D1.1/D1.1M.
- E. Obtain approval prior to site cutting or making adjustments not scheduled.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset From True Alignment: 1/4 inch.
- C. Maximum Out-of-Position: 1/4 inch.

END OF SECTION

SECTION 05 52 13 PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Free-standing railings.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors in concrete.
- B. Section 05 50 00 - Metal Fabrications: Embedded items, welding and shop painting. Placement of anchors in concrete.
- C. Section 09 21 16 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings; 2020.
- F. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination; 2020.
- G. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- H. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- I. AWS D1.6/D1.6M - Structural Welding Code - Stainless Steel; 2017, with Amendment (2021).
- J. AWS C3.4M/C3.4 - Specification for Torch Brazing; 2016.
- K. AWS C3.5M/C3.5 - Specification for Induction Brazing; 2016, with Amendment (2017).
- L. AWS C3.9M/C3.9 - Specification for Resistance Brazing; 2020.
- M. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- N. NAAMM AMP 521 - Pipe Railing Systems Manual; 2001 (reaffirmed 2012).
- O. SSPC-PA 1 - Shop, Field, and Maintenance Coating of Metals; 2024.
- P. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.
 - 1. Indicate welded connections using standard AWS A2.4 welding symbols. Indicate net weld lengths.

2. Prepare shop drawings for all railing systems, including attachment.
 3. Conform to AISC Standards, except provisions for approval/responsibility for dimensions by Architect and structural engineer do not apply.
 4. Include erection drawings, elevations, and details where applicable.
 5. Indicate welded connections using standard AWS welding symbols. Indicate net weld lengths.
- C. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated within the previous 12 months.
- D. Fabricator's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Welder Qualifications: Welding processes and welding operators qualified within previous 12 months.
- B. Fabricator Qualifications:
1. A company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- C. Coordination: Provide templates and sleeves for incorporation of embedded items into the work specified elsewhere herein.

1.06 DELIVERY, STORAGE AND HANDLING

- A. Delivery, Storage and Handling, General: Protect products from deformation, marring, discoloration, soiling and corrosion.
- B. Storage: Store products in enclosed, well-ventilated spaces, not in contact with soil or vegetation and not subject to inclement weather.

PART 2 PRODUCTS

2.01 RAILINGS - GENERAL REQUIREMENTS

- A. Regulatory Requirements: Conform to California Building Code (CBC), Title 24, Part 2, Section 11B-505 and 11B-405.8 as amended and adopted by authorities having jurisdiction.
1. Top of gripping surfaces of handrails shall be 34 inches minimum and 38 inches maximum vertically above walking surfaces, stair nosings, and ramp surfaces. Handrails shall be at a consistent height above such surfaces.
 2. Clearance between handrail gripping surfaces and adjacent surfaces shall be 1-1/2 inches minimum.
 - a. Handrail may be located in a recess if the recess is 3 inches maximum deep and 18 inches minimum clear above the top of the handrail.
 3. Handrail gripping surfaces shall be continuous along their length and shall not be obstructed along their tops or sides. The bottoms of handrail gripping surfaces shall not be obstructed for more than 20% of their length.
 - a. Where provided, horizontal projections shall occur 1-1/2 inches minimum below the bottom of the handrail gripping surfaces.
 4. Handrail gripping surfaces with a circular cross section shall have an outside diameter of 1-1/4 inch minimum and 2 inches maximum.

5. Handrail gripping surfaces with a non-circular cross section shall have an outside dimension of 4 inches minimum and 6-1/4 inches maximum, and a cross-sectional dimension of 2-1/4 inches maximum.
6. Handrail gripping surfaces and any surfaces adjacent to them shall be free of sharp or abrasive elements and shall have rounded edges.
7. Handrails shall not rotate within their fittings.
8. Handrail gripping surfaces shall extend beyond and in the same direction of stair flights and ramp runs in accordance with CBC Section 11B-505.10.
 - a. Such extensions are not required for continuous handrails at the inside turn of switchback or dogleg stairs and ramps.
9. A 2 inch minimum high curb or a barrier shall be provided to prevent the passage of a 4 inch diameter sphere rolling off the sides of a ramp surface.
 - a. Such a curb or barrier shall be continuous and uninterrupted along the length of a ramp. CBC Section 11B-405.9.2
- B. Design, fabricate, and test railing assemblies in accordance with the most stringent requirements of applicable local code.
- C. Allow for expansion and contraction of members and building movement without damage to connections or members.
- D. Dimensions: See drawings for configurations and heights.
 1. Top Rails and Wall Rails: 1-1/2 inches outside diameter, round.
 2. Intermediate Rails: 1-1/2 inches diameter, round.
- E. Provide anchors and other components as required to attach to structure, made of same materials as railing components unless otherwise indicated; where exposed fasteners are unavoidable provide flush countersunk fasteners.
 1. For anchorage to concrete, provide inserts to be cast into concrete, for welding anchors.
 2. For anchorage to stud walls, provide backing plates, for bolting anchors.
- F. Provide welding fittings to join lengths, seal open ends, and conceal exposed mounting bolts and nuts, including but not limited to elbows, T-shapes, splice connectors, flanges, escutcheons, and wall brackets.
- G. Welded and Brazed Joints: Make visible joints butt tight, flush, and hairline; use methods that avoid discoloration and damage of finish; grind smooth, polish, and restore to required finish.
 1. Ease exposed edges to a small uniform radius.
 2. Welded Joints:
 - a. Carbon Steel: Perform welding in accordance with AWS D1.1/D1.1M.
 - b. Stainless Steel: Perform welding in accordance with AWS D1.6/D1.6M.
 3. Brass/Bronze Brazed Joints:
 - a. Perform torch brazing in accordance with AWS C3.4M/C3.4.
 - b. Perform induction brazing in accordance with AWS C3.5M/C 3.5.
 - c. Perform resistance brazing in accordance with AWS C3.9M/C3.9.

2.02 STEEL RAILING SYSTEM

- A. Steel Tube: ASTM A500/A500M, Grade B cold-formed welded or seamless structural tubing.
- B. Steel Pipe: ASTM A 53/A 53M, Grade B Schedule 40, black and galvanized finish, as indicated, seamless or welded.

- C. Welding Fittings: Factory- or shop-welded from matching pipe or tube; seams continuously welded; joints and seams ground smooth.
- D. Exposed Fasteners: No exposed bolts or screws.
- E. Straight Splice Connectors: Steel concealed spigots.
- F. Galvanizing: In accordance with requirements of ASTM A123/A123M.
 - 1. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 Type I - Inorganic.

2.03 FABRICATION

- A. Fabricate railings in accordance with NAAMM AMP 521 and as required for specified design requirements. Provide stock and tubing and manufactured components sized and arranged as indicated on Drawings and specified herein.
- B. Accurately form components to suit specific project conditions and for proper connection to building structure.
 - 1. Prior to fabrication, field verify dimensions and details of construction. Immediately report variances in writing to Architect.
- C. Fit and shop assemble components in largest practical sizes for delivery to site.
- D. Fabricate components with joints tightly fitted and secured. Provide spigots and sleeves to accommodate site assembly and installation.
- E. Welded Joints:
 - 1. Exterior Components (Type 2): Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations that will not encourage water intrusion.
 - 2. Interior Components (Type 1): Continuously seal joined pieces by continuous welds.
 - 3. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius (1/8 inch).
- F. Weld connections that cannot be shop welded due to size limitations.
 - 1. Weld in accordance with AWS D1.1/D1.1M.
 - 2. Match shop welding and bolting.
 - 3. Clean welds, bolted connections, and abraded areas.
 - 4. Touch up shop primer and factory-applied finishes.
 - 5. Repair galvanizing with galvanizing repair paint per ASTM A780/A780M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive work.
- B. Coordination: Coordinate fabrication and installation of steel pipe and tube railings so that related Work accurately and properly join.

3.02 PREPARATION

- A. Obtain Architect's review prior to site cutting or making adjustments not indicated on shop drawings.
- B. Supply items required to be cast into concrete with setting templates, for installation as work of other sections.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects, with tight joints.
- C. Install railings in compliance with CBC 11B and ADA Standards for accessible design at applicable locations.
- D. Anchor railings securely to structure.
- E. Field weld anchors as indicated on drawings. Touch-up welds with primer. Grind welds smooth.
- F. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- G. Guardrails Installation: Install railings plumb and level, accurately fitted, free from distortion or defects.
 - 1. Plumb posts in each direction.
 - 2. Temporarily install sections and align before securing sections together.
 - 3. Fully weld all joints and grind smooth as for shop welding.
 - 4. Perform field welding in accordance with AWS D1.1/D1.1M.
- H. Wall Railings Installation, General: Secure handrails to wall with wall brackets and end return fittings.
 - 1. Provide brackets with 1-1/2 inch clearance from inside face of handrail and finished wall surface.
 - 2. Locate brackets as indicated, or if not indicated, at spacing required to support structural loads.
 - 3. Secure wall brackets to building construction as specified below.
 - a. Secure railing to bracket with pre-drilled hole for exposed bolt anchorage.
 - b. Railing ends: None. Return railings to within 1/4 inch of wall face and provide handrail bracket within 12 inches of end of railing.

3.04 TOLERANCES

- A. Code required dimensions indicated on Drawings as minimum or maximum are absolute. No tolerances are allowed less or more than this dimension.
- B. Maximum Variation From Plumb: 1/4 inch per floor level, non-cumulative.
- C. Maximum Offset From True Alignment: 1/4 inch.
- D. Maximum Out-of-Position: 1/4 inch.

3.05 CLEANING AND PROTECTION

- A. Galvanizing Repair Compound:
 - 1. If finish is to be painted or is otherwise not visible, field repair with premixed cold galvanizing compound for field touch-up of galvanized coatings.
 - 2. Where the finish is galvanized, resend to galvanizing for reapplication, if practical (e.g.; bolted components) and accepted by Architect.
- B. Finish Touch-Up:

1. Immediately after installation, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 requirements for touch-up of field painted surfaces.
 2. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- C. Cleaning:
1. Clean and dress all field welds, bolted connections, and abraded areas of galvanizing or shop paint on miscellaneous metal.

END OF SECTION

SECTION 06 05 73 WOOD TREATMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field-applied termiticide for wood materials.
- B. Field-applied termiticide for other building materials.
- C. Field-applied mildewcide for wood materials.
- D. Field-applied preservative treatment for wood materials.
- E. Field-applied fire-retardant treatment for wood materials.
- F. Site applied fire retardant for wood materials.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions .
- B. Section 06 10 00 - Rough Carpentry: Factory treatment for wood products.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide technical data for insulated sheathing, wood preservative materials, and application instructions.
- C. Warranty: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, and installation.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Site Applied Termiticide and Mildewcide: Correct defective Work within a twenty-five year period after Date of Final Inspection.

PART 2 PRODUCTS

2.01 FIELD-APPLIED WOOD TREATMENT

- A. Manufacturers:
 - 1. Arch Wood Protection, Inc: www.wolmanizedwood.com.

2. Green Products Company; Copper Green: greenproductsco.net.
 3. Nisus Corporation: www.nisuscorp.com/#sle.
 4. Osmose, Inc: www.osmose.com.
 5. Viance, LLC: www.treatedwood.com.
 6. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Field-Applied Termiticide for Wood: Borate mineral salt based, spray applied, penetrating termiticide.
1. Products:
 - a. Nisus Corporation; Bora-Care: www.nisuscorp.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Field-Applied Termiticide and Mildewcide: Borate mineral salt based, spray applied termiticide, mildewcide, and mold growth preventative.
1. Products:
 - a. Nisus Corporation; Bora-Care: www.nisuscorp.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Field-Applied Termiticide for Wood, Steel and Concrete: Borate mineral salt based, spray applied termiticide formulated for use on wood, steel, concrete and other building materials.
1. Active Ingredient: 40 percent minimum disodium octaborate tetrahydrate (DOT).
 2. Carrier and Penetrant: Proprietary glycol solution.
 3. Products:
 - a. Nisus Corporation; Bora-Care with Mold-Care: www.nisuscorp.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Field-Applied Mold Cleaner: Nonbleaching, oxidizer based formula with high-pH tolerant surfactant. Contains no sodium hydroxide or sodium hypochlorite.
1. Products:
 - a. Nisus Corporation; Mold Clean: www.nisuscorp.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- F. Surface-Applied Wood Preservative: Pressure treatment in accordance with AWPA U1, using water borne preservative.
1. Liquid Wood Preservative: Roller, spray, or injection formula.
 - a. Preservative Action: Fungicidal, insecticidal, and moldicidal effects.
 - b. Active Ingredients: Clear solution of 19.6 percent disodium octaborate tetrahydrate with 1.0 percent didecyl dimethyl ammonium chloride.
 - c. Carrier: Proprietary mix of propylene glycol and water.
 - d. VOC: 6.51 lb/gal.
- G. Surface-Applied Fire-Retardant:
1. Fire Retardant and Preservative Treatment: Dip- or brush-type, non-discoloring.
 - a. Number of Coats: Two.
 - b. Surface Burning Characteristics: Class A; Flame spread index of 25 or less, smoke developed index of 26 or less, when tested in accordance with ASTM E84.
 - c. Recommended Reapplication Period: Five years.

2. Basis of Design Product: Fire-Kote 100 manufactured by Universal Fire-Shield; www.firechemicals.com.
3. Other Acceptable Manufacturers:
 - a. Flame Stop, Inc.; Flame Stop II: www.flamestop.com.
 - b. Universal Fire-Shield; Fire-Kote 100: www.firechemicals.com.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 PREPARATION

- A. Remove dust, dirt and other contaminants from treatment surfaces. Remove tarpaulins, dropcloths, strippable protective films, etc., from areas to be treated. Move equipment and stored materials that block or prevent product application.

3.02 INSTALLATION - GENERAL

- A. Provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.03 FIELD-APPLIED WOOD TREATMENT

- A. Comply with manufacturer's written mixing and application instructions.
- B. Termiticide: Apply to foundations, structure, and other items indicated and as follows:
 1. Structural wood and sill plates within 24 inches, minimum, of point of contact with foundation.
 2. Wood, wood-based, and cellulosic sheathing within 24 inches, minimum, of point of contact with foundation.
 3. Concrete foundations 2 inches, minimum, from sill plate.
 4. Pipe and plumbing penetrations up to 24 inches, minimum, above slab and slab surface and within 6 inches, minimum, of pipe or penetration.
 5. Apply six inches, minimum, on both sides of control joints and construction joints in slabs and joints between slabs and abutting material.
- C. Mildewcide: Apply to wood and wood-based building materials indicated.
 1. Structural wood and sill plates within 24 inches, minimum, of point of contact with foundation.
 2. Wood, wood-based, and cellulosic sheathing within 24 inches, minimum, of point of contact with foundation.
- D. Liquid Preservative: Apply to wood and wood-based building materials indicated in accordance with manufacturer's instructions.
- E. Fire-Retardant:
 1. Apply fire-retardant and preservative treatment in accordance with manufacturer's instructions.
 - a. Verify materials do not exceed the specified percent moisture content before applying wood treatment.
 - b. Brush apply two coats of fire-retardant and preservative treatment.
 2. Apply dip- or brush-type preservative to site-sawn ends of pressure preservative treated materials. Allow preservative to cure prior to erecting materials.

3. Do not install materials until site pre-finishing and back priming is complete and dry.

END OF SECTION

SECTION 06 10 00 - ROUGH CARPENTRY

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. Framing with dimension lumber.
 - 2. Wall, Siding and roof sheathing.
 - 3. Wood furring, blocking and nailers.
 - 4. Preservative and fire-retardant treatment of wood.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal size or greater in least dimension.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.
 - 1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
 - 2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
 - 3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5664.
 - 4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

- A. 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 ALSC Board of Review.
- B. Evaluation Reports: For the following, from ICC-ES:
 - 1. Wood-preservative-treated wood.
 - 2. Fire-retardant-treated wood.
 - 3. Engineered wood products.
 - 4. Shear panels.
 - 5. Power-driven fasteners.
 - 6. Post-installed anchors.
 - 7. Metal framing anchors.

1.6 QUALITY ASSURANCE

- A. Lumber Grading Agency: Certified by ALSC.
- B. Plywood Grading Agency: Certified by APA.
- C. Accredited certification bodies shall be one of the following:
 - 1. Scientific Certification Systems, www.scscertified.com.

1.7 REGULATORY REQUIREMENTS

- A. Conform to CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Chapter 23.
- B. Allowable stress design values shall follow the CBC, California Building Code, (CCR) California Code of Regulations, Title 24, Part 2, Section 2306, ANSI/AWC NDS-2018 - National Design Specifications for Wood Construction, and ANSI/AWS SDPWS-2015 - Special Design Provisions for Wind and Seismic.

1.8 DELIVERY, STORAGE, AND HANDLING

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

PART 2 - PRODUCTS

2.1 LUMBER MATERIALS

- A. Lumber Grading Rules: WCLIB and WWP. Lumber shall bear WCLIB grade stamp.
- B. Structural Framing, Studs, Plate and Blocking: Douglas Fir Species, No. 1 grade.

- C. Non-structural Light Framing Studs, Plate and Blocking: Douglas Fir species, No. 2 grade.
- D. Plank and Decking: Douglas Fir species, Com Dex.

2.2 MOISTURE CONTENT

- A. 2x and 3x material, 19 percent moisture content, S-Dry. Structural and non-structural framing, beam, rafters, joists, studs, plates and blocking.
- B. 4x and 6x material, 19 percent moisture content at time of application of Architectural finishes. 22 percent maximum moisture content at time of delivery to project site. Materials to be air dried as required to achieve
- C. 22 percent moisture content prior to delivery to site. Structural and non-structural framing, beam, rafters, joists, studs, plates and blocking.
- D. Lumber materials with a moisture content above 19 percent and less than 22 percent at the time of installation shall be tested for moisture content prior to covering with Architectural finishes. Moisture tests shall be performed under the provisions of Section 01 45 29.
- E. No lumber shall be covered with an Architectural finish until the moisture content of the lumber is 19 percent or below.

2.3 PLYWOOD MATERIALS

- A. Roof Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product Standard PS-1-09.
- B. Wall Sheathing: APA Structural I, Grade C-D, Exposure 1 minimum 5-ply construction, meeting product standard PS-1-09.
- C. T1-11 Wall Sheathing: APA 303 Siding.
- D. Underlayment: APA Underlayment, Exposure 1, 3/8-inch-thick, sanded; minimum 3-ply construction.
- E. Telephone and Electrical Panel Boards: APA Grade C-D with exterior glue, minimum 5 ply, 3/4-inch-thick, meeting PS-1-09.

2.4 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment: Where lumber or plywood is indicated as treated or is specified herein to be treated, comply with applicable requirements of AWPA Standards for Lumber and Plywood.
- B. Pressure treat all lumber in contact with ground. After treatment kiln-dry lumber to a maximum moisture content of 19 percent.
- C. Pressure treat above ground items as indicated. After treatment, kiln-dry lumber and plywood to a maximum moisture content, respectively, of 19 percent and 15 percent. Treat indicated items 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. Horizontal wood sills, sleepers, blocking, furring, stripping and similar concealed members in contact with masonry or concrete.
 3. Horizontal wood framing members less than 18 inches above grade.
 4. Wood floor plates installed over concrete slabs directly in contact with earth.
 5. Ends of wood girders entering masonry or concrete walls.
 6. Framing members used in exterior door, window, or louver openings.
- D. Complete fabrication of treated items prior to treatment, where possible. If cut or drilled after treatment, coat cut or drilled surfaces with heavy brush coat of same chemical used for treatment and to comply with AWPAC M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.5 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D 5664 and design value adjustment factors shall be calculated according to ASTM D 6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.

F. Application: Treat items indicated on Drawings, and the following:

1. Concealed blocking.
2. Framing for non-load-bearing partitions.
3. Framing for non-load-bearing exterior walls.
4. Roof construction.
5. Plywood backing panels.

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. Dimension Lumber Items: Douglas Fir, No. 2 grade lumber.

C. For blocking not used for attachment of other construction, No. 2 grade lumber of any species may be used if it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

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

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

2.7 ACCESSORIES

A. Fasteners: Hot-dipped galvanized steel for exterior, high humidity, and treated wood locations; plain finish elsewhere; size and type to suit condition.

B. Connectors: As indicated.

C. Anchors: Thru bolt or anchor bolt to concrete or masonry unless otherwise noted. Bolt for anchorage to steel unless otherwise noted.

D. Building Paper: No. 15 asphalt felt. Plain untreated cellulosic building paper.

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

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

G. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193 or ICC-ES AC308 as appropriate for the substrate.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.
2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.8 MISCELLANEOUS MATERIALS

- A. Sill-Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch thick, selected from manufacturer's standard widths to suit width of sill members indicated.
- B. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
- C. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.
- D. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with ANSI/AWC NDS-2018, "National Design Specification (NDS) for Wood Construction – with 2018 NDS Supplement," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Install shear wall panels to comply with manufacturer's written instructions.
- F. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- G. Install sill sealer gasket to form continuous seal between sill plates and foundation walls.
- H. Do not splice structural members between supports unless otherwise indicated.
- I. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.
- J. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than 100 sq. ft. and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 10 feet o.c.
- K. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- L. Comply with AWP A U1 and M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- M. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- N. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.10.1, "Fastening Schedule," in the 2019 California Building Code.
 2. ICC-ES evaluation report for fastener.
- O. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- P. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.
1. Comply with approved fastener patterns where applicable. Before fastening, mark fastener locations, using a template made of sheet metal, plastic, or cardboard.
 2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
 3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 FRAMING

- A. Erect wood framing members level and plumb.
- B. Place horizontal members laid flat, crown side-up.
- C. Construct framing members full length without splices.
- D. Double members at openings over 1 sq. ft. Space short stud over and under opening to stud spacing.
- E. Construct double joist headers at floor and ceiling openings. Frame rigidly into joists.
- F. Construct double joists under wall studding.

3.3 WOOD FURRING, BLOCKING, AND GROUNDS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Item locations include but are not limited to toilet accessories, toilet partitions, door frames, window frames, hardware, access doors and ladders, cabinetry, miscellaneous equipment locations and mechanical, plumbing and electrical item locations and all other locations of wall mounted items.
- C. Install plywood backboards for telephone, data and other electrical equipment.
- D. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.
- E. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise indicated.
- F. Build into masonry during installation of masonry work. Where possible, anchor to formwork before concrete placement.
- G. Install plumb and level with closure strips at edges and openings. Shim with wood as required for tolerance of finished work.
- H. Firestop all concealed spaces of wood stud walls, ceilings and floor levels at 10-foot intervals both vertically and horizontally.
- I. Firestop all concealed vertical and horizontal spaces as occur at soffits, vents, stair stringers, pipes and similar openings in compliance with CBC, (CCR) Title 24, Part 2, Section 717.
- J. Fire stopping shall consist of closely fitted wood blocks of 2-inch nominal thickness lumber of same width as framing members.
- K. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

3.4 SHEATHING

- A. Secure roof sheathing perpendicular to framing members with ends staggered. Secure sheet edges over firm bearing. Provide solid edge blocking between sheets. Space panels 1/8 inch apart at ends and edges.
- B. Secure wall sheathing perpendicular to wall studs, with ends staggered, over firm bearing.
- C. Install telephone and electrical panel back boards where required. Size of backboards to be 12 inches beyond size of electrical panel boards.

3.5 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.
- B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet enough that moisture content exceeds that specified, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

3.6 RECYCLING CONSTRUCTION WASTE

- A. Recycle lumber waste under the provisions of Division 01 specifications.

3.7 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Division 01 specifications.
- B. Lumber materials will be inspected for compliance with material grading rules, limitations for moisture content and pest infestation prior to any materials being concealed from view or being covered with an architectural finish.

3.8 TOLERANCES

- A. Framing Members: 1/4 inch maximum from true position.
- B. Surface Flatness of Floor: 1/4 inch in 10 feet maximum.

END OF SECTION 06 10 00

SECTION 06 16 00 - SHEATHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Wall sheathing.
- B. Roof sheathing.
- C. Subflooring.
- D. Underlayment.

1.2 REFERENCES

- A. The publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by the basic designation only. Refer to Division 01 for definitions, acronyms, and abbreviations.
- B. Unless otherwise noted, standards, manuals, and codes refer to the latest edition of such standards, manuals, and codes.
- C. Referenced Standards:
 - 1. AATCC Test Method 127 – Water Resistance: Hydrostatic Pressure Test.
 - 2. APA AFG-01 – Adhesives for Field-Gluing Plywood to Wood Framing.
 - 3. ASTM A153/A153M – Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 4. ASTM A653/A653M – Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - 5. ASTM B117 – Standard Practice for Operating Salt Spray (Fog) Apparatus.
 - 6. ASTM C834 – Standard Specification for Latex Sealants.
 - 7. ASTM C954 – Standard Specification for Steel Drill Screws for the application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness.
 - 8. ASTM D3498 – Standard Specification for Adhesives for Field-Gluing Plywood to Lumber Framing for Floor Systems.
 - 9. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 10. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials.
 - 11. ASTM F1667 – Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
 - 12. AWPA U1 – Use Category System: User Specification for Treated Wood.
 - 13. The Engineered Wood Association (APA); Plywood Specifications and Grades.

- 14. The Engineered Wood Association (APA) E30S – Engineered Wood Construction Guide.
- 15. UL Fire Resistance Directory.

1.3 SUBMITTALS

- A. General: Submit in accordance with Division 01.
- B. Product Data: Submit manufacturer's descriptive literature and product specification for each product.
- C. Certification:
 - 1. Pressure Treated Plywood: Submit certification for water-borne preservative stating that moisture content was reduced to 19 percent, maximum, after treatment.
 - 2. Pressure Treated Plywood: Submit certification by treatment plant stating the chemicals and process used, net amount of salts retained, and conformance with applicable standards.

1.4 QUALITY ASSURANCE

- A. Qualifications:
 - 1. Manufacturer Qualifications: Firm specializing in manufacturing products specified in this Section with a minimum 5 years experience.
 - 2. Installer Qualifications: Firm specializing in installing work specified in this Section acceptable to manufacturer with experience on at least 5 projects of similar nature in past 3 years.
- B. Regulatory Requirements: Comply with requirements of 2022 California Building Code (CBC), Chapter 23, "Wood," and Chapter 25, "Gypsum Board and Plaster."
 - 1. Grading, fire-retardant treatment, and preservative treatment of plywood shall conform to Section 2303, "Minimum Standards and Quality."
 - 2. Plywood Sheathing and Subflooring: Refer to Section 2304, Article 2304.6, "Wall Sheathing," Article 2304.7, "Floor and Roof Sheathing," Table 2304.6, and Tables 2304.7(1) through 2304.7(5).
 - 3. Fastener Requirements: Refer to Section 2304, Article 2304.9, "Connections and Fasteners," and Table 2304.9.1, "Fastening Schedule."
 - a. Additional DSA-SS Fastening Requirements: Refer to Section 2304, Article 2304.9.1.1, "Additional Requirements."
- C. Coordinate work in this Section with work in related Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of Division 01.
- B. Deliver products in manufacturer's original containers, dry and undamaged, with seals and labels intact.
- C. Storage and Protection:
 - 1. Store materials in a dry secure place; neatly stacked to prevent sagging or damage to edges, ends, and surfaces. Protect from weather, surface contaminants, corrosion, construction traffic, and other potential damage.

2. Stack plywood and other panels flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

1.6 ENVIRONMENTAL REQUIREMENTS

- A. Environmental Requirements: Maintain uniform moisture content of lumber at 19 percent or less at time of installation.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- A. Plywood Structural Sheathing and Structural Subflooring: Each panel shall be legibly identified as to type, grade and specie by APA grade. If plies are spliced, the slope of the scarf shall not be steeper than 1:8. White pockets will not be permitted in face plies.

2.2 WOOD PANEL PRODUCTS, GENERAL

- A. Plywood: DOC PS 1 or DOC PS 2.
- B. Oriented Strand Board: DOC PS 2.
- C. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.
- D. Application: Treat plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 PRESERVATIVE-TREATED PLYWOOD

- A. Preservative Treatment by Pressure Process: AWP A U1.
 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.
- B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

2.4 FIRE-RETARDANT-TREATED PLYWOOD

- A. General: Comply with performance requirements in AWP A U1.
 1. Use treatment that does not promote corrosion of metal fasteners.
 2. Use Exterior type for exterior locations and where indicated.
 3. Use Interior Type A, Low Temperature (LT) unless otherwise indicated. (Refer to U1, Commodity Specification H.)
 4. Use Interior Type A, High Temperature (HT) for roof sheathing and where indicated. (Refer to U1, Commodity Specification H.)
- B. Kiln-dry material after treatment to a maximum moisture content of 15 percent. Do not use material that is warped or does not comply with requirements for untreated material.
- C. Identify fire-retardant-treated plywood with appropriate classification marking of UL, U.S. Testing, Timber Products Inspection, or another testing and inspecting agency acceptable to authorities having jurisdiction.

D. Application: Treat plywood in the following locations:

1. Roof and wall sheathing within 48 inches of fire walls.
2. Roof sheathing.
3. Subflooring and underlayment for raised platforms.

2.5 WALL SHEATHING

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

- 1) Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum, LLC; DensGlass Sheathing or comparable product by one of the following:

- a) CertainTeed Corporation.
- b) Continental Building Products, LLC.
- c) National Gypsum Company.
- d) USG Corporation.

- 2) Type and Thickness: Regular, 1/2 inch thick.

- 3) Size: 48 by 96 inches for vertical installation.

B. Plywood Wall Sheathing: Exterior, Structural I; Exterior; Exposure 1, Structural I; or Exposure 1 sheathing as appropriate to intended application.

1. Span Rating: As appropriate for intended application.

2.6 ROOF SHEATHING

A. See Section 075419 PVC Roofing.

2.7 SUBFLOORING AND UNDERLAYMENT

A. Plywood Combination Subfloor-Underlayment: DOC PS 1, Exterior, Structural I; C-C Plugged; Exterior, C-C Plugged; Exposure 1, Structural I, Underlayment; or Exposure 1, Underlayment single-floor panels as appropriate for intended application.

B. Plywood Subflooring: Exterior, Structural I; Exterior; Exposure 1, Structural I; or Exposure 1 sheathing as appropriate to intended application, single-floor panels or sheathing.

1. Span Rating: As appropriate for intended application.

C. Underlayment, General: Provide underlayment in nominal thicknesses indicated or, if not indicated, not less than 1/4 inch over smooth subfloors and not less than 3/8 inch over board or uneven subfloors.

1. Plywood Underlayment for Resilient Flooring: DOC PS 1, with fully sanded face.
2. Plywood Underlayment for Carpet: DOC PS 1.

2.8 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.
 - 1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.
 - 2. Code Requirements: Refer to CBC Chapter 23, Section 2304, Article 2304.9, "Connections and Fasteners," and Table 2304.9.1, "Fastening Schedule."
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.
 - 1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117.
- E. Screws for Fastening Oriented-Strand-Board-Surfaced, Polyisocyanurate-Foam Sheathing to Metal Roof Deck: Steel drill screws, in type and length recommended by sheathing manufacturer for thickness of sheathing board to be attached, with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B117. Provide washers or plates if recommended by sheathing manufacturer.

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Field Gluing Panels to Wood Framing: Formulation complying with APA AFG-01 or ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine job site conditions and verify field dimensions.
- B. Verify framing for acceptable placement, spacing, and tolerance (alignment and plumb).
- C. Verify that framing and furring are securely attached.
- D. Verify that all blocking, headers, and supports are in place to support plumbing fixtures, grab bars, towel racks, shelves, and similar items.
- E. Verify that insulation (thermal or acoustical) is secured.
- F. Verify firestopping work; refer to Section 07 84 00.
- G. Verify that surfaces to be bonded with an adhesive are free of dust, dirt, grease, and any other foreign matter.

3.2 INSTALLATION, GENERAL

- A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction, unless otherwise indicated.
- C. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.
- D. Coordinate wall and roof sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
- E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
- F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.3 WOOD STRUCTURAL PANEL INSTALLATION

A. General:

- 1. Comply with applicable recommendations in APA Form No. E30S, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.
- 2. Plywood Structural Sheathing and Structural Subflooring: Install to pattern indicated and provide blocking at joints where noted on Drawings. Center all joints over bearing supports. Nail to framing as indicated. Install plywood with face plies perpendicular to joists or studs unless indicated otherwise. Where plywood is the substrate for exterior plaster finish, leave 1/8 inch gaps at butt end joints and 1/16 inch gaps at horizontal joints.

B. Fastening Methods: Fasten panels as indicated below:

1. Roof and Wall Sheathing:

- a. Nail to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
- b. Screw to cold-formed metal framing.
- c. Space panels 1/8 inch apart at edges and ends.

2. Combination Subfloor-Underlayment:

- a. Glue and nail to wood framing.
- b. Screw to cold-formed metal framing.
- c. Space panels 1/8 inch apart at edges and ends.

3. Subflooring:

- a. Glue and nail to wood framing.
- b. Screw to cold-formed metal framing.

- c. Space panels 1/8 inch apart at edges and ends.
 - 4. Underlayment:
 - a. Nail or staple to subflooring.
 - b. Space panels 1/32 inch apart at edges and ends.
 - c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.
 - C. Nailing Requirements: Except as otherwise specified, all nailing shall be as scheduled on Drawings:
 - 1. Nails or Spikes shall be common wire unless noted otherwise. Penetration of nails or spikes shall be one-half the length of the nail or spike into the piece receiving the point. However, to connect pieces 2 inch in thickness, 16d nails shall be used unless noted otherwise.
 - a. Bore holes for nails wherever necessary to prevent splitting. Hole size shall not exceed 75 percent of nail diameter.
 - b. Use finish or casing nails for finish work.
 - 2. Use of nailing guns is limited by CBC requirements and subject to approval by DSA. Submit nailing gun and nail data for approval.
- 3.4 TOLERANCES
- A. Maximum variation from true flatness: 1/4 inch in 10 feet in any direction.
- 3.5 CLEANING AND PROTECTION
- A. Cleaning and Repair: Clean surfaces that have been spotted or soiled during sheathing application.
 - B. Defective Work: Remove and replace defective work that cannot be satisfactorily repaired, at no cost to Owner.
 - C. Protection: Protect installed work against damage from other construction work.
 - D. Upon completion of the work of this Section, remove all surplus material, rubbish and debris from the premises and leave floors broom clean.

END OF SECTION 06 16 00

SECTION 06 17 33 WOOD I-JOISTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wood I-joists for roof framing.
- B. Bridging, bracing, and anchorage.
- C. Framing for openings.
- D. Preservative treatment of wood.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Installation requirements for miscellaneous framing.
- C. Section 06 10 00 - Rough Carpentry: Material requirements for blocking, plates, and miscellaneous framing.

1.03 REFERENCE STANDARDS

- A. ASTM D5055 - Standard Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists; 2019, with Editorial Revision (2020).
- B. AWWA U1 - Use Category System: User Specification for Treated Wood; 2023.
- C. DSA IR 23-9 - Prefabricated Wood I-Joist; Current adopted edition.
- D. PS 2 - Performance Standard for Wood Structural Panels; 2018.

1.04 DESIGN REQUIREMENTS

- A. Joists shall be sized and detailed to fit the dimensions and loads indicated on Drawings.
- B. Designs shall be in accordance with allowable values and section properties assigned and approved by the building code.
- C. Design of joists shall be verified upon request of Architect by submission of complete calculations.
- D. Blocking and bracing shall be provided to stabilize joists during fabrication, wind uplift, use of bottom chord for splay wires, or any other type of support.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's literature describing materials, dimensions, allowable spans and spacings, bearing and anchor details, bridging and bracing requirements, and installation instructions; identify independent inspection agency.
- C. Shop Drawings: Indicate sizes and spacing of joists, bracing and bridging, bearing stiffeners, holes to be cut (if any), and framed openings between joists.
 - 1. Shop Drawings show all critical dimensions for determining fit and placement in the building as well as loads the members are designed to support. Review of shop drawings shall be completed prior to fabrication. Drawings shall be prepared by a Civil or Structural Engineer Licensed in California.

2. Calculations: Submit structural calculations prepared by a Civil or Structural Engineer licensed in California.
- D. Certificate: Certification by joist manufacturer that products delivered are of the same design and construction as those evaluated by the independent inspection agency.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years of documented experience.
 1. Documented experience includes manufacturing and delivering specified products to projects of similar size and scope in California.
 2. Manufacturer shall have a current ICC Evaluation Report for the products provided.
 3. Products shall be fabricated in a facility licensed by the Los Angeles Department of Building and Safety.
- B. Source Limitations for Engineered Wood Products: Obtain each type of engineered wood product through one source from a single manufacturer.
- C. Regulatory Requirements:
 1. Conform to California Building Code (CBC), Title 24, Part 2, Chapter 23 with additional requirements for Division of the State Architect.
 2. Manufacture and installation to comply with DSA IR 23-9.
 3. Manufacturer to provide current valid evaluation report..
- D. In addition to conforming with all applicable Codes and regulations, manufacture joists in a plant approved for fabrication by Division of the State Architect, and to follow the guidelines of the evaluation report.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Piece mark and wrap joists in packages before arrival at jobsite.
- B. Deliver products to site in manufacturer's original packaging with manufacturer's name and product identification intact and legible.
- C. Protect products from damage due to weather and breakage.
- D. Protect joists from warping or other distortion by stacking in upright position, braced to resist movement, with air circulation under coverings and around stacks.
- E. Handle individual joists in the upright position.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Wood I-Joists:
 1. Basis of Design and DSA Approval: RedBuilt I-Joist, ICC ESR-2994 (Formerly Trus-Joist; iLevel by Weyerhaeuser): www.redbuilt.com, or approved equal.
 2. Boise Cascade Company: www.bc.com/#sle. ICC ESR-1144, ESR-1336, and VAR-1017.
 3. Louisiana-Pacific Corporation: www.lpcorp.com/#sle. ICC ESR-1305
 4. Weyerhaeuser Company: www.weyerhaeuser.com/#sle. ICC ESR-1153 and VAR-1008.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

- a. Substitution may or may not be accepted after Architect and District review with complete evaluation for content and schedule impact.
- b. Substitutions shall include all costs for redesign with consequential changes by other trades along with the Architect and related approvals by governing agencies. Revisions to shop drawings illustrating changes is not considered adequate for DSA review and approval.
- c. Substitutions may be acceptable, based on Architect's review and approval, for submittal to DSA. If substituted manufacturer cannot reproduce DSA design and approval in a timely manner, then they shall be subject to a time and material back charge for any delays in the project. Architect approval is required prior to DSA submittal and DSA approval is required prior to installation.

2.02 MATERIALS

- A. Wood I-Joists: Laminated veneer lumber top and bottom flanges and oriented strand board (OSB) webs bonded together with structural adhesive, with published span rating to meet project requirements.
 1. Size and type, plus load and deflection criteria, shall be as indicated on Drawings.
 2. Wood Chord Members:
 - a. Micro-laminated LVL per ICC Report ESR-2993, moisture content of 7-16 percent at time of fabrication, or equal.
 3. Web: As indicated in ESR Report.
 - a. Oriented Strand Board (OSB), meeting PS2, Exposure 1.
 4. Span Rating: Established and monitored in accordance with ASTM D5055 by independent inspection agency.
 5. Oriented Strand Board: Comply with PS 2.
 6. Adhesive: Tested for wet/exterior service in accordance with ASTM D2559.
 - a. Provide I-joists manufactured without urea formaldehyde.
 7. Depth: As indicated on drawings.
 8. Fabrication:
 - a. Verify dimensions and site conditions prior to fabrication.
 - b. Fabricate with continuous chords.
 - c. Install web with ends jointed to form a continuous web.
 - d. Apply adhesive to groove centered in wide face of flange and pressure form and fit web into groove.
 - e. Include all extended ends and ceiling extensions, headers, bridging, shear blocks and panels, end supports, and end anchors required for complete installation.
 9. Fabrication Tolerances:
 - a. Flange Width: Plus/minus 1/32 inch.
 - b. Flange Thickness: Minus 1/16 inch.
 - c. Joist Depth: Plus 0, minus 1/8 inch.
 10. Marking: Mark each piece with depth, joist spacing, and allowable span for joist spacing.
 11. Provide bearing stiffeners if required by span rating or joist hanger manufacturer.
- B. Wood-Based Components:

1. Wood fabricated from old growth timber is not permitted.
- C. Joist Bridging: Type, size and spacing recommended by joist manufacturer, and as indicated on Drawings.
- D. Rim Boards: As designed to be used as a load-bearing member and to brace wood I-joists at bearing ends, complying with applicable research/evaluation report.
- E. Wood Blocking, Plates, and Miscellaneous Framing: As specified in Section 06 10 00.
 1. Also provide framing anchors and fasteners as required and recommended by joist manufacturer, as applicable.
- F. Fasteners: Electrogalvanized steel, type to suit application.

2.03 WOOD TREATMENT

- A. Factory-Treated Lumber and Plywood: Comply with requirements of AWWA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that supports and openings are ready to receive joists.
- B. Verify that field measurements are as indicated on shop drawings.

3.02 PREPARATION

- A. Coordinate placement of bearing items.
- B. Coordination and Scheduling:
 1. Coordinate and sequence joist installation and details with Work specified in other Sections.
 2. Ensure proper interface of joists with adjoining components, to minimize cutting and penetration of joists
 3. Limit erected joists to the shortest possible exposure to the elements before closing-in of building envelope.

3.03 ERECTION

- A. Erect and secure joists as indicated on Drawings, the reviewed shop drawings.
- B. Install joists in accordance with manufacturer's instructions and recommendations.
- C. Set structural members true to line, level and plumb, in correct position.
- D. Make provisions for erection loads and for sufficient temporary bracing to maintain structure plumb and in true alignment until completion of erection and installation of permanent bracing.
- E. Do not field cut or alter structural members without approval of Architect.
- F. Install permanent bridging and bracing.
 1. Provide erection bracing in addition to specified bridging to keep joists straight and plumb and to assure adequate lateral support until sheathing material has been applied.
 2. Install headers and supports to frame openings required.
- G. Frame openings between joists with lumber in accordance with Section 06 10 00 and as indicated on Drawings.

- H. Blocking and Stiffeners: Install blocking and stiffeners as required and shown for lateral support of members, to provide nailing surface for sheathing and finish materials and to fire-block cavities in accordance with Code.
- I. Coordinate installation of sheathing/decking with work of this section.
- J. Construction Loads: Do not permit temporary construction loads which cause member stresses beyond design limits.

3.04 SITE APPLIED WOOD TREATMENT

- A. Apply preservative treatment in accordance with manufacturer's instructions.
- B. Brush apply one coat of preservative treatment on wood in contact with cementitious materials. Treat site-sawn cuts.
- C. Allow preservative to dry prior to erecting members.

3.05 TOLERANCES

- A. Framing Members: 1/2 inch maximum, from true position.

END OF SECTION

SECTION 06 18 00 GLUED-LAMINATED CONSTRUCTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glue laminated wood beams and purlins.
- B. Preservative treatment of wood.
- C. Steel hardware and attachment brackets.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. AITC 108 - Standard for Heavy Timber Construction; 1993.
- B. AITC 110 - Standard Appearance Grades for Structural Glued Laminated Timber; 2001.
- C. AITC 111 - Recommended Practice for Protection of Structural Glued Laminated Timber During Transit, Storage and Erection; 2005.
- D. AITC 117 - Standard Specifications for Structural Glued Laminated Timber of Softwood Species; 2010.
- E. AITC A190.1 - American National Standard for Wood Products - Structural Glued Laminated Timber; 2007.
- F. ANSI 117 - Standard Specification for Structural Glued Laminated Timber of Softwood Species; 2020.
- G. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- H. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- K. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts; 2021a.
- L. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric); 2021a.
- M. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- N. ASTM D3737 - Standard Practice for Establishing Allowable Properties for Structural Glued Laminated Timber (Glulam); 2012.
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength; 2023.
- P. AWPA M4 - Standard for the Handling, Storage, Field Fabrication and Field Treatment of Preservative-Treated Wood Products; 2023.

- Q. AWP A U1 - Use Category System: User Specification for Treated Wood; 2023.
- R. AWS B2.1/B2.1M - Specification for Welding Procedure and Performance Qualification; 2021.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- T. DSA IR 23-10 - Structural Glued Lumber; Current adopted edition.
- U. RIS (GR) - Standard Specifications for Grades of California Redwood Lumber; 2019.
- V. SPIB (GR) - Standard Grading Rules; 2021.
- W. WCLIB (GR) - Standard Grading Rules for West Coast Lumber No. 17; 2018.
- X. WWP A G-5 - Western Lumber Grading Rules; 2021.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide technical data on wood preservative materials, application technique and resultant performance information.
 - 1. Include data on lumber, adhesives, fabrication, and protection.
 - 2. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treatment plant that treated materials comply with requirements.
 - 3. Indicate type of preservative used, net amount of preservative retained, and chemical treatment manufacturer's written instructions for handling, storing, installing, and finishing treated materials.
 - 4. Research/Evaluation Reports: For structural glued-laminated timber and connectors.
 - 5. Certifications:
 - a. Submit an AITC inspection certificate, signed by a Division of the State Architect approved fabricator, stating that the glue laminated wood members were produced in accordance with AITC A190.1.
 - b. Submit certification by a DSA approved treating plant that required treatments comply with specified standards.
- C. Shop Drawings: Indicate framing system, sizes and spacing of members, loads and cambers, bearing and anchor details, bridging and bracing, framed openings .
 - 1. Show layout of structural glued-laminated timber system and full dimensions of each member. Indicate species and laminating combination, adhesive type, and other variables in required work.
 - 2. Include large-scale details of connections, connectors, and other accessories.
- D. Manufacturer's Qualification Statement.
- E. Welders' Qualification Statement: Welders' certificates in accordance with AWS B2.1/B2.1M and dated no more than 12 months before start of scheduled welding work.
- F. Erector's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Manufacturer/Fabricator Qualifications: Company specializing in manufacture of glue laminated structural units with three years of documented experience, and certified by AITC in accordance with AITC A190.1.
 - 1. Produce factory-glued structural units by an AITC - or APA-licensed firm approved by DSA and qualified to apply the AITC "Quality Inspected" mark..

- B. Erector Qualifications: Company specializing in erection of products of the type specified with five years documented experience, and approved by manufacturer.
- C. Welder Qualifications: Welding processes and welding operators qualified in accordance with AWS D1.1/D1.1M and no more than 12 months before start of scheduled welding work.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with provisions in AITC 111, "Recommended Practice for Protection of Structural Glued Laminated Timber during Transit, Storage, and Erection."
- B. Protect members to AITC requirements for individually wrapped.
 - 1. Individually wrap members that are to be exposed in the final installation using plastic-coated paper covering with water-resistant seams. Bundle wrap all other members.
- C. Leave individual wrapping in place until finishing occurs.
 - 1. Open end of wrapping and loosen at job site to facilitate air circulation.
- D. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Conform to ASCE 7 code for loads, seismic zoning, and other load criteria.
- B. Except as modified by the requirements specified herein or as indicated, provide glue laminated wood meeting the requirements of the California Building Code (CBC) Title 24 Part 2, Chapter 23 with additional requirements for Division of the State Architect, including maximum moisture content allowable at time of fabrication.
 - 1. Comply with DSA IR 23-10.

2.02 MANUFACTURERS

- A. Glued-Laminated Structural Units:
 - 1. Basis of Design and DSA Approval: RedBuilt LLC: www.redbuilt.com, or approved equal.
 - 2. American Laminators; DSA inspected: www.americanlaminators.com.
 - 3. Boise Cascade Company; ICC ESR VAR-1017: www.bc.com/#sle.
 - 4. Western Wood Structures, Inc: www.westernwoodstructures.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 GLUED-LAMINATED UNITS

- A. Glued-Laminated Units: Fabricate in accordance with AITC 117 Industrial grade.
 - 1. Appearance Grade: As indicated above unless indicated otherwise on the Drawings, complying with AITC 110.
 - a. Use clear wood inserts, of matching grain and color, for filling voids and knot holes more than 1/4 inch wide.
 - b. Exposed and Partially Exposed Members: Architectural appearance grade.
 - c. Other Members: May have an Industrial appearance grade.
 - 2. Verify dimensions and site conditions prior to fabrication.
 - 3. Cut and fit members accurately to length to achieve tight joint fit.

4. Fabricate member with camber built in.
 5. Do not splice or join members in locations other than those indicated without permission.
 6. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
 7. Welding: Perform welding in accordance with AWS D1.1/D1.1M.
 8. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
- B. Performance Criteria:
1. Comply with applicable code for loads, seismic zoning, and other load criteria.
 2. Design and laminate members in accordance with ANSI 117, or determined according to ASTM D3737 and acceptable to authorities having jurisdiction (Division of the State Architect).
 3. Seismic Performance: Provide structural glued-laminated timber, including connectors, capable of withstanding the effects of earthquake motions determined according to ASCE 7.
 - a. Seismic Design Criteria: See Drawings.

2.04 MATERIALS

- A. General: Provide structural glued-laminated timber that complies with AITC 117 manufacturing or research/evaluation reports acceptable to authorities having jurisdiction.
1. Provide structural glued-laminated timber made from a single species.
- B. Lumber: Softwood lumber conforming to WCLB grading rules with 12 percent maximum moisture content before fabrication.
1. Species and Grades for Structural Glued-Laminated Timber: Provide structural glued-laminated timber made from species and grades as indicated on Drawings.
- C. Lumber: Softwood lumber complying with RIS (GR) grading rules with 12 percent maximum moisture content before fabrication. As indicated on Structural Drawings.
1. Lumber: Softwood lumber complying with RIS (GR) grading rules with 12 percent maximum moisture content before fabrication. As indicated on Structural Drawings
 2. Laminating Combinations: Provide laminating combinations meeting the requirements of ANSI/AITC A190.1 and provide the above allowable design values based on dry condition of service.
 3. Lumber fabricated from old growth timber is not permitted.
- D. Steel Connections and Brackets: ASTM A36/A36M weldable quality, galvanize per ASTM A123/A123M.
1. Hot-rolled steel sheet complying with ASTM A1011/A1011M, Structural Steel, Type SS, Grade 33.
 2. Finish: Where "Wet Use" work is indicated, finish fabricated assemblies with hot dip zinc coating, ASTM A153/A153M, including bolts and other fasteners per CBC Title 24, Part 2, Sec. 2304.10.1.1.
- E. Anchor Bolts: ASTM F3125/F3125M, Type 1 heavy hex high strength bolts and ASTM A563 (ASTM A563M) nuts; hot-dip galvanized to meet requirements of ASTM A153/A153M, matching washers.
- F. Laminating Adhesive: AITC A190.1.
1. Use adhesive that contains no added urea-formaldehyde resins.

G. Wood Sealer:

1. Penetrating Sealer: Manufacturer's standard, transparent, penetrating wood sealer that is compatible with indicated finish.
 - a. After fabrication and sanding of each unit, and end coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit.
2. End Sealer: Manufacturer's standard, transparent, colorless wood sealer that is effective in retarding the transmission of moisture at cross-grain cuts and is compatible with indicated finish.
 - a. Immediately after end cutting each member to final length, and after wood treatment, apply a saturation coat of end sealer to ends and other cross cut surfaces, keeping surfaces "flood coated" for not less than 10 minutes.

H. Metal Primer: Finish steel assemblies and fasteners with rust-inhibitive primer 2-mil dry film thickness.

2.05 WOOD TREATMENT

- A. Factory-Treated Lumber: Comply with requirements of AWP A U1 - Use Category System for pressure impregnated wood treatments determined by use categories, expected service conditions, and specific applications.
- B. Preservative Pressure Treatment: Where exposed to weather.
 1. Manufacturers:
 - a. Lonza Group: www.wolmanizedwood.com/#sle.
 - b. Osmose Utilities Services, Inc: www.osmose.com/#sle.
 - c. Viance, LLC: www.treatedwood.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 2. Preservative Pressure Treatment of Glued-Laminated Structural Units: AWP A U1, Use Category UC3B, Commodity Specification F using waterborne preservative to 0.25 lb/cu ft retention.
 - a. Kiln dry lumber after treatment and before lamination to maximum moisture content of 19 percent.
 3. Marking: Marked each piece with stamp of an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWP A standards.
- C. Surface-Applied Wood Preservative:
 1. Use preservative solution without water repellents or substances that might interfere with application of indicated finishes.
 2. After dressing and fabricating members, apply a field-treatment preservative to comply with AWP A M4 to surfaces cut to a depth of more than 1/16 inch.
 - a. Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - b. Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- D. Shop treat wood materials in accordance with manufacturer's instructions.

2.06 FABRICATION

- A. Fabricate glue laminated structural members in accordance with AITC Industrial grade.

1. Moisture Content: Control moisture content at time of gluing and fabrication in accordance with AITC A190.1.
- B. End joints may be either a plane scarf having a slope not steeper than 1:10 or an approved finger joint.
 1. Unless specifically approved by the Division of the State Architect (DSA), there shall be a minimum of 60 test specimens provided to qualify an end joint.
 2. All portions of end joints in adjacent laminations shall be separated in accordance with AITC A190.1 and ASTM D3737.
 3. The areas requiring 6 inch spacing shall be shown on the approved Shop Drawings.
 4. Joints in adjacent laminations of members with vertically oriented glue lines shall be separated as required for bending members.
 5. There shall be no knots or other defects within 6 inches of finger joints in areas where a 6 inch separation of joints in adjacent laminations is specified or within 2 knot diameters elsewhere.
- C. Shop fabricate for connections to greatest extent possible, including cutting to length and drilling bolt holes.
 1. Dress exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
- D. Welding: Perform welding in accordance with AWS D1.1/D1.1M.
- E. Verify dimensions and site conditions prior to fabrication.
- F. Cut and fit members accurately to length to achieve tight joint fit.
- G. Fabricate member with camber built in.
 1. Fabricate horizontal and inclined members of less than 1:1 slope with either circular or parabolic camber equal to 1/480 of span.
- H. Do not splice or join members in locations other than those indicated without permission.
- I. Fabricate steel hardware and connections with joints neatly fitted, welded, and ground smooth.
- J. After end trimming, seal with penetrating sealer in accordance with AITC requirements.
 1. End-Cut Sealing: Immediately after end-cutting each member to final length and after preservative treatment, apply a saturation coat of end sealer to ends and other cross-cut surfaces, keeping surfaces flood-coated for not less than 10 minutes.
 2. Seal Coat: After fabricating, sanding, and end-coat sealing, apply a heavy saturation coat of penetrating sealer on surfaces of each unit, except for preservative-treated wood where treatment included a water repellent.
- K. Field Finishing of Members: Specified in Section 09 91 13 and 09 91 23.
- L. Factory Finishing:
 1. Wiped Stain Finish: Manufacturer's standard, dry-appearance, penetrating acrylic stain and sealer; oven dried and resistant to mildew and fungus.
 - a. Color: As selected by Architect from manufacturer's full and custom range..
 2. Clear Finish: Manufacturer's standard, two-coat, clear conversion varnish finish; oven dried and resistant to mildew and fungus.
- M. Factory Applied Protection:
 1. Individually wrap each Architectural grade member for shipment with heavy water resistant paper in accordance with AITC 111. Individually or bundle wrap Industrial grade members at manufacturer's option.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that supports are ready to receive units.
- B. Verify sufficient end bearing area.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Coordinate placement of bearing items.
- B. Coordinate routing of pipes, ductwork and conduits to avoid penetrations through glue laminated structural units.

3.03 ERECTION

- A. Lift members using protective straps to prevent visible damage.
- B. Erect members as indicated and in accordance with AITC 108 and the approved Shop Drawings and instructions of the fabricator. Erect structural glued-laminated timber with uniform, close-fitting joints.
 - 1. Install structural glued-laminated timber to comply with Shop Drawings.
 - 2. Install timber connectors as indicated.
- C. Set structural members level and plumb, in correct positions or sloped where indicated.
- D. Provide temporary bracing and anchorage to hold members in place until permanently secured.
- E. Fit members together accurately without trimming, cutting, splicing, or other unauthorized modification.
 - 1. If required by field conditions, not manufacturer error, fit structural glued-laminated timber by cutting and restoring exposed surfaces to match specified surfacing and finishing.
 - a. Predrill for fasteners using timber connectors as templates.
 - b. Dress exposed surfaces to remove planing or surfacing marks and to provide a finish equivalent to that produced by machine sanding with No. 120 grit sandpaper.
 - c. Coat crosscuts with end sealer.
 - d. Where preservative-treated members must be cut during erection, apply a field-treatment preservative to comply with AWP A M4.
 - 1) Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.
 - 2) Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
 - 2. Cutting: Avoid extra cutting after fabrication. Where field fitting is unavoidable, comply with requirements for shop fabrication.
 - a. Where preservative-treated members must be cut during erection, apply a field-treatment preservative (heavy brush coat of the same preservative treatment used during fabrication) to comply with AWP A M4 and applicable air quality regulations for VOC.
 - 1) Use inorganic boron (SBX) treatment for members not in contact with the ground and continuously protected from liquid water.

- 2) Use copper naphthenate treatment for members in contact with the ground or not continuously protected from liquid water.
- F. Swab and seal the interior wood surfaces of field drilled holes in members with primer.
- G. Field Finishing: Specified in Section 09 91 13 and 09 91 23.

3.04 TOLERANCES

- A. Framing Members: 1/2 inch maximum from true position.

3.05 ADJUSTING

- A. Repair damaged surfaces and finishes after completing erection. Replace damaged structural glued-laminated timber if repairs are not approved by Architect.

3.06 PROTECTION

- A. Do not remove wrappings on individually wrapped members until they no longer serve a useful purpose including protection from weather, sunlight, soiling, and damage from work of other trades.
 - 1. Coordinate wrapping removal with finishing work specified in Division 9. Retain wrapping where it can serve as a painting shield.

END OF SECTION

SECTION 06 20 00 FINISH CARPENTRY

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Finish carpentry items.
- B. Hardware and attachment accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.03 REFERENCE STANDARDS

- A. ANSI A135.4 - Basic Hardboard; 2012 (Reaffirmed 2020).
- B. ANSI A208.1 - American National Standard for Particleboard; 2022.
- C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. HPVA HP-1 - American National Standard for Hardwood and Decorative Plywood; 2020.
- F. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- G. PS 1 - Structural Plywood; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with installation of associated and adjacent components.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Provide manufacturer's product data, storage and handling instructions for factory-fabricated units.
 - 2. Provide instructions for attachment hardware and finish hardware.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide the information required by AWMAC/WI (NAAWS).
 - 3. Include certification program label.
- D. Samples: Submit two samples of wood trim 6 inch long.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project within the past 5 years with value of woodwork within 20 percent of cost of woodwork for this project.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Store finish carpentry items under cover, elevated above grade, and in a dry, well-ventilated area not exposed to heat or sunlight.
- B. Protect from moisture damage.

PART 2 PRODUCTS

2.01 FINISH CARPENTRY ITEMS

- A. Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Surface Burning Characteristics: Provide materials having fire and smoke properties as required by applicable code.
- C. Interior Woodwork Items:
 - 1. Moldings, Bases, Casings, and Miscellaneous Trim: Match existing; prepare for stained transparent finish.

2.02 LUMBER MATERIALS

- A. Softwood Lumber: Douglas Fir species, S4S sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.
- B. Hardwood Lumber: Drawing indicated species, S4S sawn, maximum moisture content of 6 percent; with vertical grain, of quality suitable for transparent finish.

2.03 SHEET MATERIALS

- A. Softwood Plywood, Not Exposed to View: Any face species, veneer core; PS 1 Grade A-B, glue type as recommended for application.
- B. Softwood Plywood, Exposed to View: Face species as indicated, plain sawn, veneer core; PS 1 Grade A-B, glue type as recommended for application.
- C. Hardwood Plywood: Face species as indicated, plain sawn, book matched, medium density fiberboard core; HPVA HP-1 Front Face Grade AA, Back Face Grade 1, glue type as recommended for application.
- D. Particleboard: ANSI A208.1 Composed of wood chips, sawdust, or flakes of medium density, made with waterproof resin binders; of grade to suit application; sanded faces.
- E. Hardboard: ANSI A135.4 Pressed wood fiber with resin binder, Class 1 - Tempered, 1/4 inch thick, smooth one side (S1S).

2.04 PANEL CORE MATERIALS

- A. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
 - 1. Grade: 115; moisture resistance: MR10.
 - 2. Panel Thickness: 3/4 inch.

2.05 PLASTIC LAMINATE MATERIALS

- A. Plastic Laminate: NEMA LD 3, HGS; color as selected by Architect; textured, low gloss finish.
- B. Laminate Backing Sheet: NEMA LD 3, BKL; undecorated plastic laminate.
- C. Laminate Adhesive: Type recommended by laminate manufacturer to suit application; not containing formaldehyde or other volatile organic compounds.

2.06 UPHOLSTERY

- A. Polyurethane Foam: Density not less than 2.2 lb/cu ft, fire retardant, non-hardening and non-oxidizing, with high resistance to alkalis, oils, moisture, and mildew.
- B. Upholstery Fabric: Manufacturer, fabric designation, color, and pattern; as selected by Architect.
 - 1. UPH-1 Basis of Design Fabrics:
 - a. Maharam

2.07 FASTENINGS

- A. Adhesive for Purposes Other Than Laminate Installation: Suitable for the purpose; not containing formaldehyde or other volatile organic compounds.
- B. Fasteners: Of size and type to suit application; blind finish in concealed locations and Architect selected finish in exposed locations.

2.08 ACCESSORIES

- A. Adhesive: Type recommended by fabricator to suit application.
- B. Lumber for Shimming and Blocking: Softwood lumber of indicated species.
- C. Aluminum Edge Trim: Extruded convex shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; bronze anodized finish.
- D. Wood Filler: Oil base, tinted to match surface finish color.

2.09 SITE FINISHING MATERIALS

- A. Stain and Finishing Materials: Comply with AWMAC/WI (NAAWS), unless noted otherwise.

2.10 FABRICATION

- A. Shop assemble work for delivery to site, permitting passage through building openings.
- B. Cap exposed plastic laminate finish edges with aluminum trim.
- C. When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- D. Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
- E. Apply laminate backing sheet to reverse face of plastic laminate finished surfaces.

2.11 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.

- C. On items to receive transparent finishes, use wood filler that matches surrounding surfaces and is of type recommended for the applicable finish.
- D. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 12, Polyurethane, Water-based.
 - b. Stain: As selected by Architect.
 - c. Sheen: Semigloss.
- E. Back prime woodwork items to be field finished, prior to installation.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.

3.02 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Set and secure materials and components in place, plumb and level.
- C. Carefully scribe work abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim to conceal larger gaps.
- D. Install components with nails at 12 inch on center.

3.03 PREPARATION FOR SITE FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

3.04 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 41 00 ARCHITECTURAL WOOD CASEWORK

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Specially fabricated cabinet units. PL1 & PL-2.
- B. Hardware. HW-02, HW-04, HW-05, HW-06
- C. Factory finishing.
- D. Preparation for installing utilities.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.
- C. Section 06 20 00 - Finish Carpentry: Wood trim unrelated to casework.
- D. Section 12 36 00 - Countertops.

1.03 REFERENCE STANDARDS

- A. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- F. BHMA A156.9 - Cabinet Hardware; 2020.
- G. CBC - California Building Code; Current Adopted Edition.
- H. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- I. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- J. WI (CCP) - Certified Compliance Program (CCP); Current Edition.
- K. WI (CSIP) - Certified Seismic Installation Program (CSIP); Current Edition.
- L. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting not less than one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.

2. Provide the information required by AWI/AWMAC/WI (AWS) or AWMAC/WI (NAAWS).
3. Include certification program label.
- C. Product Data: Provide data for hardware accessories.
- D. Samples: Submit actual samples of architectural cabinet construction, minimum 12 inches square, illustrating proposed cabinet, countertop, and shelf unit substrate and finish.
- E. Samples: Submit actual sample items of proposed pulls, hinges, shelf standards, and locksets, demonstrating hardware design, quality, and finish.
- F. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project:
 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 2. Spare Parts: One of each kind of lock.
 3. Extra Stock Materials: six keys of each kind of lock.

1.06 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
 - a. A Licensee of the Woodwork Institute's Certified Compliance Program.
 3. Single Source Responsibility: Provide and install this work from single fabricator.
- B. Quality Certification:
 1. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section:
<https://woodworkinstitute.com/#sle>.
 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 3. Provide designated labels on shop drawings as required by certification program.
 4. Provide designated labels on installed products as required by certification program.
 - a. Before delivery to the jobsite the woodwork supplier shall provide a Woodwork Institute Certified Compliance Certificate indicating the millwork products being supplied and Certifying that these products fully meet the requirements of the Grade or Grades specified.
 - b. Each elevation of casework, each laminated plastic top, and each solid surface top shall bear a Woodwork Institute Certified Compliance Label.
 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - a. 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.

6. All fees charged by the Woodwork Institute for their Certified Compliance program are the responsibility of the millwork manufacturer and/or installer and shall be included in the bid.
7. Replace, repair, or rework all work for which certification is refused.

1.07 MOCK-UPS

- A. Provide mock-up of typical base cabinet, wall cabinet, and countertop, including hardware, finishes, and plumbing accessories.
- B. See Section 01 40 00 - Quality Requirements for additional requirements.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect units from moisture damage.

1.09 FIELD CONDITIONS

- A. During and after installation of custom cabinets, maintain temperature and humidity conditions in building spaces at same levels planned for occupancy.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Wall hung cabinets and floor supported cabinets over 5 feet high shall be braced and anchored in accordance with the California Building Code (CBC) Title 24 Part 2, Table 1607A.1.
 1. Comply with OHSPD Pre-Approval OPM-0092.
- B. Requirements for Persons with Disabilities: Provide products meeting requirements of California Code of Regulations (CCR), Title 24, Part 2, CBC, CBC Ch. 11B, and ADA Standards, latest amendment.
 1. Operable parts for all accessible casework shall comply with CBC Ch. 11B-309 Operable Parts.
 2. Pull hardware shall be U-shaped wire pulls or equally accessible at all accessible casework; CBC Ch. 11B-811.4 Operable Parts.

2.02 CABINETS

- A. Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Plastic Laminate Faced Cabinets: Custom grade.
- C. Cabinets:
 1. Finish - Exposed Exterior Surfaces: Decorative laminate.
 2. Finish - Exposed Interior Surfaces: Decorative laminate.
 3. Finish - Semi-Exposed Surfaces: Cabinet Liner.
 - a. Cabinet interiors (other than exposed interior surfaces of open or glass front cabinets) including faces of shelving therein, and interior door faces.
 4. Finish - Concealed Surfaces: Manufacturer's option.
 5. Door and Drawer Front Edge Profiles: Square edge with thick applied band.

- a. Provide with subfronts and applied finish fronts securely fastened, with square corners, edges finished with 3 mm purified PVC.
 - b. Doors, Drawer Fronts, and False Fronts: 3 mm purified PVC edge band, color and pattern to match exposed laminate, hot-melt applied.
 - c. All other exposed and semi exposed edges: 1 mm PVC edge band, color and pattern to match exposed laminate.
6. Door and Drawer Front Retention Profiles: Fixed panel.
7. Casework Construction Type: Type A - Frameless.
8. Interface Style for Cabinet and Door: Style 1 - Overlay; reveal overlay.
 - a. Hinged to swing flat against the face of adjoining cabinet or the side of cabinet
 - b. Do not notch door or cabinet ends, or divisions to receive hinge.
9. Patterned Face Layout for Cabinet and Door Fronts: Flush panel.
 - a. Custom Grade: Doors, drawer fronts and false fronts wood grain to run and match vertically within each cabinet unit.
10. Cabinet Design Series: As indicated on drawings.
 - a. 100 Series - Base Cabinets without drawers.
 - b. 200 Series - Base Cabinets with drawers.
 - c. 300 Series - Wall hung Cabinets.
 - d. 400 Series - Tall Storage Cabinets.
 - e. 500 Series - Wardrobe Cabinets.
11. Adjustable Shelf Loading: 40 psf.
 - a. Deflection: L/144.
 - b. Shelves: 1-M-2 particle board, 1 inch thick, MOE of 950.
 - c. Edge Bands: 1 mm PVC in color to match shelf. All 4 edges of adjustable shelves to receive banding.
12. Cabinet Style: Flush overlay.
13. Cabinet Doors and Drawer Fronts: Flush style.
14. Drawer Side Construction: Manufacturer's option.
15. Drawer Construction Technique: As recommended by fabricator.

2.03 WOOD-BASED COMPONENTS

- A. Wood fabricated from old growth timber is not permitted.
- B. Provide sustainably harvested wood, certified or labeled; see Section 01 60 00.
- C. Lumber shall be sound, kiln dried softwood and/or hardwood meeting the requirements of the NAAWS Grade specified for its intended purpose.

2.04 PANEL CORE MATERIALS

- A. Panels shall contain no added urea-formaldehyde resins and shall be in accordance with the NAAWS requirements for the grade specified.
- B. Medium Density Fiberboard (MDF): Composite panel composed of cellulosic fibers, additives, and bonding system; cured under heat and pressure; comply with ANSI A208.2.
 1. Grade: 155; moisture resistance: MR10.
 - a. Comply with NAAWS, ANSI A208.2, Grade 150 minimum, where required by CSIP.

2. Panel Thickness: 3/4 inch.
3. Products:
 - a. Basis of Design Material: Combination Core, PureBond Classic Core, www.columbiaforestproducts.com, or approved equal.
 - b. Roseburg Forest Products: www.roseburg.com/#sle.
 - c. Timber Products; Pro Core MDF: www.timberproducts.com.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.

2.05 LAMINATE MATERIALS

- A. Manufacturers: PL-1, PL-2, PL-3, PL-4, & PL-5.
 1. Abet - Laminati: www.abetlaminati.com
 2. Formica Corporation: www.formica.com/#sle.
 3. Wilsonart LLC: www.wilsonart.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Flame Spread Rating ASTM E84: Provide 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. CBC Table 803.13.
 1. Class C Flame spread rating 26-200, smoke developed 0-450 per ASTM E84.
- D. Provide specific types as indicated.
 1. Horizontal Surfaces: HGS, 0.048 inch nominal thickness, color as selected, textured low gloss finish.
 2. Vertical Surfaces: VGS, 0.028 inch nominal thickness, color as selected, textured low gloss finish.
 3. Post-Formed Horizontal Surfaces: HGP, 0.039 inch nominal thickness, color as selected, finish as selected.
 4. Post-Formed Vertical Surfaces: VGP, 0.028 inch nominal thickness, color as selected, finish as selected.
 5. Cabinet Liner: CLS, 0.020 inch nominal thickness, color as selected, finish as indicated.
 6. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.06 COUNTERTOPS

- A. Countertops: See Section 12 36 00.

2.07 ACCESSORIES

- A. Adhesive: Type recommended by NAAWS to suit application.
 1. Type I.
 2. Urea Formaldehyde adhesives shall not be used.
 3. Contact Cement: VOC content of less than 80 g/l.
 4. Construction adhesive shall have a VOC content compliant with Section 01 61 16.
 5. Manufacturers:

- a. Franklin International, Inc; Titebond Original Wood Glue: www.titebond.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Aluminum Edge Banding: Extruded flat shape; smooth surface finish; self locking serrated tongue; of width to match component thickness; clear anodized finish.
 1. Use at all exposed plywood edges.
 2. Use at all exposed shelf edges.
- C. Aluminum Trim and Mouldings: Extruded, alloy 6063 T5.
 1. Type: Profile as selected from manufacturer's standard range.
 2. Finish: Clear anodized.
- D. Aluminum Reveal: Extruded shape; smooth surface finish; of width to match component thickness; clear anodized finish.
 1. Basis of Design Product: JDM-50 as manufactured by Fry Reglet, or approved equal.
- E. Fasteners: Size and type to suit application.
- F. Bolts, Nuts, Washers, Lags, Pins, and Screws: Of size and type to suit application; galvanized or chrome-plated finish in concealed locations and stainless steel or chrome-plated finish in exposed locations.
- G. Concealed Joint Fasteners: Threaded steel.

2.08 HARDWARE

- A. Cabinet Hardware: Comply with BHMA A156.9 for hardware types and grades indicated below:
 1. Hardware Types: As indicated on drawings.
 2. Product Grade: Grade 2.
- B. Adjustable Shelf Supports: Standard side-mounted system using multiple holes for pin supports and coordinated self rests, polished chrome finish, for nominal 1 inch spacing adjustments.
 1. HW-5 Basis of Design: 1/4 inch diameter, Angle 282.11.761, Nickel plated, provide minimum of 4 per shelf manufactured by Hafele.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Drawer and Door Pulls: "U" shaped pull, stainless steel with satin finish, 6 inch centers.
 1. Comply with CBC 11B-811.4.
 2. HW-02: Mockett #DP130A
 3. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Keyed Cabinet Locks: Keyed cylinder, two keys per lock, master keyed, steel with chrome finish.
 1. HW-6 Basis of Design: Cam Locks, National Lock C8053-14A, complying with ANSI/BHMA A156.11, Grade 1 manufactured by Hafele.
 2. Provide locks on approximately 50 percent of all cabinet doors and drawers, except accessible sink bases, and as follows:
 - a. A.V. Cabinets.
 - b. Tall Storage Cabinets.
 - c. Display Cabinets.
 - d. Wardrobe.

- e. Work Area.
 - f. "Personal" Drawers.
 - g. Filing Cabinets.
 - h. Workrooms to have locks on all doors and drawers.
 - i. Nurse's office to have locks on all doors and drawers.
 - 3. Key locks alike for doors and drawers for each room and master keyed.
 - 4. Master key project in accordance with District's keying requirements.
 - a. Coordinate with District's keying at a keying meeting held with the Construction Manager.
 - b. Provide for the District's review a keying schedule as part of the final shop drawings.
 - 5. Metal Strike Plates: Provide cabinet door and drawer locks with metal strike plates to protect against particle board rip out.
 - 6. Door and drawer locks shall be of pin tumbler design and include working cylinder slides and forwardly removable cylinder to re-key without totally disassembling lock body and passed by ANSI Grade 1 testing.
 - 7. Locks shall be easily rekeyable pin tumbler with working top slide and retainer staple.
- E. Cabinet Catches and Latches:
- 1. Type: Magnetic catch.
 - 2. Catches for Doors Without Locks: Magnetic with aluminum case.
 - a. Amerock; Product No. 145: www.amerock.com.
 - b. The Engineered Products Co.; Product EP591: www.epcohardwaresecurity.com.
 - c. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com/#sle.
 - d. Rockler Companies, Inc: www.rockler.com/#sle.
 - e. Stanley Architectural Hardware; Product CD46.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Catches for Inactive Leaf of Pairs of Doors With Locks: Elbow catch.
 - a. Amerock; Product E.Z. Flex No. 3675-2G: www.amerock.com.
 - b. The Engineered Products Co.; Product No. 1016: www.epcohardwaresecurity.com.
 - c. Ives; Product 2-A92: www.iveshinges.com.
 - d. Knappe & Vogt Manufacturing Company: www.knappeandvogt.com/#sle.
 - e. Rockler Companies, Inc: www.rockler.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Drawer Slides:
- 1. Type: Full extension, no deflection.
 - 2. Static Load Capacity: As required by drawer size.
 - a. For drawers up to 18 inches wide and less than 4 inches in depth, provide slides with 100 pound capacity.
 - b. For drawers over 18 inches in width and over 4 inches in depth, provide slides with 150 pound capacity.
 - c. Drawer slide capacity with paper storage: 200 pounds.
 - 3. Mounting: Side mounted.

4. Stops: Positive type.
5. Features: Provide self closing/stay closed type.
 - a. With rolling balls, steel rollers and self-lubricating bearings.
6. Manufacturers:
 - a. Basis of Design: Full extension, heavy duty, side mount manufactured by Hafele.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- G. Hinges: Concealed (fully mortised) self-closing type, BHMA No. A156.9 level, Grade 1, steel with polished finish.
 1. Manufacturers:
 - a. HW-4 Basis of Design: 165 degree concealed hinge manufactured by Hafele.
 - b. Blum, Inc; CLIP top BLUMOTION: www.blum.com/#sle.
 - c. Grass America Inc: www.grassusa.com/#sle.
 - d. Hafele America Co.; : www.hafele.com.
 - e. Stanley Hardware Div.: www.stanleycommercialhardware.com.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

2.09 SITE FINISHING MATERIALS

- A. Stain, Varnish, and Finishing Materials: In compliance with AWMAC/WI (NAAWS), unless noted otherwise.

2.10 FABRICATION

- A. Assembly: Shop assemble cabinets for delivery to site in units easily handled and to permit passage through building openings.
- B. Edging: Fit shelves, doors, and exposed edges with specified edging. Do not use more than one piece for any single length.
- C. Fitting: When necessary to cut and fit on site, provide materials with ample allowance for cutting. Provide matching trim for scribing and site cutting.
- D. Plastic Laminate: Apply plastic laminate finish in full uninterrupted sheets consistent with manufactured sizes. Fit corners and joints hairline; secure with concealed fasteners. Slightly bevel arises. Locate counter butt joints minimum 2 feet from sink cut-outs.
 1. Apply laminate backing sheet to reverse side of plastic laminate finished surfaces.
 2. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. Mechanically fasten back splash to countertops with steel brackets at 16 inches on center.
- F. Provide cutouts for plumbing fixtures. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

2.11 SHOP FINISHING

- A. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 1. Transparent:
 - a. System - 12, Polyurethane, Water-based.
 - b. Stain: As selected by Architect.
 - c. Sheen: Flat.

2. Opaque:
 - a. System - 4, Latex Acrylic, Water-based.
 - b. Color: As selected by Architect.
 - c. Sheen: Flat.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify adequacy of backing and support framing.
- B. Verify location and sizes of utility rough-in associated with work of this section.

3.02 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
 1. Install in accordance and comply with WI Certified Seismic Installation Program (WI (CSIP)).
 - a. Certified Seismic Casework Installation:
 - 1) All wood or metal frame wall construction shall be constructed with continuous in wall blocking of either 3x6 flat Douglas Fir, 16 ga. x 6 inch wide, or as indicated on the AHJ approved structural drawings, 50 KSI sheet metal provided in accordance with the location requirements included on the cabinet fabricator/installer's shop drawings. Responsibility for blocking installation shall be that of the wall fabricator.
 - 2) All casework installation shall be certified by the Woodwork Institute in accordance with their Certified Seismic Installation Program (WI (CSIP)), including:
 - (a) A CSIP Certificate indicating that all of the casework installation fully meets the requirements of the AWMAC/WI (NAAWS) and WI (CSIP).
 - 3) It is the responsibility of the installer to include within their bid, any and all costs for WI (CSIP) certification. Certification is a prerequisite for final acceptance. For further information, please visit www.woodworkinstitute.com
 2. Provide a WI Certified Compliance Certificate for installation as specified herein.
- B. Set and secure custom cabinets in place, assuring that they are rigid, plumb, and level.
 1. Install plumb, level, true and straight with no distortions. Shim as required using concealed shims. Scribe and cut for accurate fit.
 2. Base Cabinets: Set cabinets straight, plumb, and level. Adjust sub-tops within 1/16 inch of a single plane. Fasten each individual cabinet to floor at toe space, with fasteners spaced 12 inches on center. Bolt continuous cabinets together. Secure individual cabinets with not less than 2 fasteners into floor, where they do not adjoin other cabinets.
 - a. Where required, assemble units into one integral unit with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.
 3. Wall Cabinets: Securely fasten woodwork per WI (CSIP). Standards (as adopted by WI) to solid supporting wall framing material, not plaster, lath, or gypsum board. Anchor, adjust, and align wall cabinets as specified for base cabinets.
 - a. Reinforcement of stud walls to support wall-mounted cabinets specified in appropriate section, but responsibility for accurate location and sizing of reinforcement shall be coordinated with applicable trade.

- C. Use fixture attachments in concealed locations for wall mounted components.
- D. Use concealed joint fasteners to align and secure adjoining cabinet units.
 - 1. Install without distortion so that doors and drawers fit openings and are accurately aligned.
- E. Carefully scribe casework abutting other components, with maximum gaps of 1/32 inch. Do not use additional overlay trim for this purpose.
- F. Secure cabinets to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood; finish flush with surrounding surfaces.
- H. 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.

3.03 ADJUSTING

- A. Adjust installed work.
- B. Adjust moving or operating parts to function smoothly and correctly.

3.04 CLEANING

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

END OF SECTION

SECTION 06 42 00 WOOD PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Custom wood plastic Laminate paneling.
- B. Shop finishing.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 06 10 00 - Rough Carpentry: Grounds and concealed blocking.
- C. Section 06 20 00 - Finish Carpentry: Wood trim unrelated to casework.
- D. Section 06 41 00 - Architectural Wood Casework: Shop fabricated custom cabinet work.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard; 2022.
- B. ASTM B136 - Standard Method for Measurement of Stain Resistance of Anodic Coatings on Aluminum; 1984(2013) .
- C. ASTM B244 - Standard Test Method for Measurement of Thickness of Anodic Coatings on Aluminum and of Other Nonconductive Coatings on Nonmagnetic Basis Metals with Eddy-Current Instruments; 2009 (2021).
- D. ASTM D1730 - Standard Practices for Preparation of Aluminum and Aluminum-Alloy Surfaces for Painting; ; 2009 (Reapproved 2014).
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- G. NEMA LD 3 - High-Pressure Decorative Laminates; 2005.
- H. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on fire-retardant treatment materials and application instructions.
- C. Shop Drawings: Indicate materials, component profiles, fastening methods, jointing details, and accessories.
 - 1. Scale of Drawings: 1-1/2 inch to 1 foot, minimum.
 - 2. Provide plan of panel number sequencing.
 - 3. Provide information as required by AWMAC/WI (NAAWS).
 - 4. Include certification program label.
- D. Samples: Submit two samples of finished plywood, 6 x 6 inch in size, illustrating wood grain and specified finish.

- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

1.05 QUALITY ASSURANCE

- A. Fabricator Qualifications: Company specializing in fabricating the products specified in this section with minimum five years of documented experience.
 - 1. Company with at least one project in the past 5 years with value of woodwork within 20 percent of cost of woodwork for this Project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- B. Quality Certification:
 - 1. Comply with WI (MCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section www.woodworkinstitute.com/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Protect work from moisture damage.
- B. Do not deliver wood materials to project site until building is fully enclosed and interior temperature and humidity are in accordance with recommendations of AWMAC/WI (NAAWS).

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable codes for fire-retardant requirements.

2.02 PANELING

- A. Quality Standard: Custom Grade, in accordance AWMAC/WI (NAAWS), unless noted otherwise.
- B. Flat Paneling:
 - 1. Species: As indicated on Drawings.
 - 2. Cut: As indicated on Drawings.
 - 3. Panels: Veneer of full width and balanced sequence matched.
 - a. Panels More Than One Leaf High: Architectural end matching.
 - b. Each Panel Within Single Area: Full width premanufactured sets, and doors and other components.
 - 4. Visible Edges and Reveals: As indicated on drawings.
 - 5. Outside Corners: As indicated on drawings.
 - 6. Blueprint Match: Room As indicated on Drawings.

- a. Grade: Premium.
- b. Provide casework, paneling, doors and wood trim by same manufacturer.
- c. Obtain veneer from the same flitch as selected by Architect.
- d. Faces at Cabinet Doors, Drawer Fronts, and False Fronts: Sequence matched, to run and match vertically, and be sequence matched with adjacent wall paneling and doors or both.
- e. Faces at Exposed Ends of Cabinets: Select veneer from same flitch and matching adjacent paneling and cabinet fronts.
- f. Factory finish components including casework, paneling, doors, and trim at the same time in the same facility.

2.03 PLASTIC LAMINATE FACED PANELING

- A. Finish - Exposed Exterior Surfaces: Decorative laminate.
- B. Visible Edges and Reveals: As indicated on drawings.
- C. Outside Corners: As indicated on drawings.

2.04 WOOD-BASED MATERIALS - GENERAL

- A. Particleboard: Composed of wood chips, medium density, with waterproof resin binders; of grade to suit application; sanded faces; complying with ANSI A208.1.

2.05 LAMINATE MATERIALS

- A. Manufacturers:
 1. Abet - Laminati: www.abetlaminati.com
 2. Formica Corporation: www.formica.com/#sle.
 3. Lamin-Art: www.laminart.com.
 4. Wilsonart LLC: www.wilsonart.com/#sle.
 5. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. High Pressure Decorative Laminate (HPDL): NEMA LD 3, types as recommended for specific applications.
- C. Flame Spread Rating ASTM E84: Provide 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. CBC Table 803.13.
 1. Class C Flame spread rating 26-200, smoke developed 0-450 per ASTM E84.
- D. Provide specific types as indicated.
 1. Vertical Surfaces: VGS, 0.028 inch nominal thickness, color as selected, textured low gloss finish.
 2. Laminate Backer: BKL, 0.020 inch nominal thickness, undecorated; for application to concealed backside of panels faced with high pressure decorative laminate.

2.06 ALUMINUM MILLWORK TRIMS

- A. Basis of Design Product: Millwork Trim Reveal MWR 50-50 as manufactured by Fry Reglet, or equal.
- B. Reveals / Channels:
 1. Millwork Reveal

- a. Acceptable Product: Number MWR:
 - b. Characteristics:
 - 1) Description: Provides a straight, uniform reveal horizontally or vertically between panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
2. Millwork Channel with Return Keys:
 - a. Acceptable Product: Number MWC.
 - b. Characteristics:
 - 1) Description: Features return keys to cover cut edges of millwork panels, and provides a straight, uniform reveal horizontally, or vertically between panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
3. Millwork Reveal F:
 - a. Acceptable Product: Number MWRF.
 - b. Characteristics:
 - 1) Description: Provides a straight, uniform reveal horizontally, or vertically at the edge of panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
4. Millwork Channel F with Return Key:
 - a. Acceptable Product: Number MWCF.
 - b. Characteristics:
 - 1) Description: Features return key to cover cut edges of millwork panels and provides a straight, uniform reveal horizontally or vertically at the edge panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
5. Millwork Retainer:
 - a. Acceptable Product: Number MWRET.
 - b. Characteristics:
 - 1) Description: Fry Reglet Millwork Retainer installed in conjunction with Millwork Insert provides a straight uniform reveal to be used horizontally or vertically at ends of millwork.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
6. Millwork Insert with Return Keys:
 - a. Acceptable Product: Number MWINST
 - b. Characteristics:
 - 1) Description: Fry Reglet Millwork Insert installed in conjunction with Millwork Retainer provides a straight uniform reveal to be used horizontally or vertically at ends of millwork.

- 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 7. Millwork Reveal L:
 - a. Acceptable Product: Number MWRL.
 - b. Characteristics:
 - 1) Description: Provides a straight, uniform edge to be used horizontally or vertically at ends of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 8. Millwork Channel L with Return Key:
 - a. Acceptable Product: Number MWCL.
 - b. Characteristics:
 - 1) Description: Provides a $\frac{3}{16}$ " thick, straight and uniform edge to be used horizontally or vertically at ends of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 9. Millwork Reveal ISC:
 - a. Acceptable Product: Number MWRISC.
 - b. Characteristics:
 - 1) Description: 90-degrees inside corner provide straight and uniform edge at ends of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 10. Millwork Channel ISC L with Return Keys:
 - a. Acceptable Product: Number MWCISC.
 - b. Characteristics:
 - 1) Description: 90-degrees inside corner provide straight and uniform return keys to cover cut edges of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 11. Millwork Reveal OSC:
 - a. Acceptable Product: Number MWROSC.
 - b. Characteristics:
 - 1) Description: 90-degrees outside corners, are abuse resistant and provides straight, uniform edge at end of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
- 12. Millwork Channel OSC with Return Keys:
 - a. Acceptable Product: Number MWCOSC.
 - b. Characteristics:

- 1) Description: 90-degrees outside corners, are abuse resistant and provides straight, uniform edge at end of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
13. 4" Millwork Reveal Base:
 - a. Acceptable Product: Number MWRB.
 - b. Characteristics:
 - 1) Description: Features an exposed 4" base flange that provides a straight, uniform base horizontally at the bottom of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
14. 4" Millwork Channel Base with Return Key:
 - a. Acceptable Product: Number MWCB.
 - b. Characteristics:
 - 1) Description: Features an exposed $\frac{3}{16}$ " return key to cover cut edges of millwork panels, and a 4" base flange that provides a straight, uniform base horizontally at the bottom of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
15. Millwork $\frac{1}{8}$ " Post:
 - a. Acceptable Product: Number MWP.
 - b. Characteristics:
 - 1) Description: provides a $\frac{1}{8}$ " thick, straight and uniform post to be used horizontally or vertically between panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
16. Millwork $\frac{1}{8}$ " Post Termination:
 - a. Acceptable Product: Number MWPT.
 - b. Characteristics:
 - 1) Description: provides a $\frac{1}{8}$ " thick, straight and uniform post to be used horizontally or vertically at the edge of panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
17. Millwork $\frac{1}{4}$ " Post:
 - a. Acceptable Product: Number MWP.
 - b. Characteristics:
 - 1) Description: provides a $\frac{1}{4}$ " thick, straight and uniform post to be used horizontally or vertically between panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
18. Millwork $\frac{1}{4}$ " Post Termination:

- a. Acceptable Product: Number MWPT.
 - b. Characteristics:
 - 1) Description: provides a 1/4" thick, straight and uniform post to be used horizontally or vertically at the edge of panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
19. Millwork 1/4" Post OSC:
- a. Acceptable Product: Number MWPOSC.
 - b. Characteristics:
 - 1) Description: 90-degrees outside corners, are abuse resistant, and provides a straight and uniform 1/4" exposed post at edges of millwork panels.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
20. Millwork Corner Key:
- a. Acceptable Product: Number MWCK.
 - b. Characteristics:
 - 1) Description: Provides a straight and uniform edge horizontally or vertically at outside corners.
 - 2) Material: Extruded aluminum.
 - 3) Dimensions: As indicated on drawings.
21. LED U Channel:
- a. Acceptable Product: Number LED-MWU.
 - b. Characteristics:
 - 1) Description: Provides a continuous band of light horizontally or vertically.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
22. LED Millwork Reveal:
- a. Acceptable Product: Number LED-MWR.
 - b. Characteristics:
 - 1) Description: Provides a continuous band of light horizontally or vertically.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
23. LED Millwork Channel with Return Keys:
- a. Acceptable Product: Number LED-MWC.
 - b. Characteristics:
 - 1) Description: Features exposed return keys to cover cut edges of millwork panels and provides a continuous band of light horizontally or vertically.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
24. LED Millwork Reveal F:

- a. Acceptable Product: Number LED-MWRF.
 - b. Characteristics:
 - 1) Description: Provides a continuous band of light horizontally or vertically at ends of millwork.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
25. LED Millwork Channel F with Return Key:
- a. Acceptable Product: Number LED-MWCF.
 - b. Characteristics:
 - 1) Description: Features an exposed return key to cover cut edges of millwork panels and provides a continuous band of light horizontally or vertically.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
26. LED Millwork Reveal F Base:
- a. Acceptable Product: Number LED-MWRB.
 - b. Characteristics:
 - 1) Description: Provides a continuous band of light horizontally or vertically at ends of millwork. Different heights and finish options available.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
27. LED Millwork Channel F with Return Key:
- a. Acceptable Product: Number LED-MWCB.
 - b. Characteristics:
 - 1) Description: Features an exposed return key to cover cut edges of millwork panels and provides a continuous band of light horizontally or vertically. Different heights and finish options available.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
28. LED Millwork Reveal 135 OSC:
- a. Acceptable Product: Number LED-MWCF.
 - b. Characteristics:
 - 1) Description: Ensures a straight and true outside corner and provides a continuous band of light vertically at corners of millwork.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.
29. Millwork Cleat:
- a. Acceptable Product: Number MWCLEAT25.
 - b. Characteristics:
 - 1) Description: Provides straight, secure, horizontal attachments at the substrate.
 - 2) Material: Extruded aluminum, LED, Frosted Lens.
 - 3) Dimensions: As indicated on drawings.

C. Materials and Finish:

1. Clear Anodized finish (Standard): Architectural 200R1 medium etch (AA-M32c10A21), clear color.
2. Chemical Conversion Coat Finish (Standard): Treatment of aluminum moldings shall conform with ASTM D1730, Type B.
3. Color Anodized Finish
 - a. Coated with impregnated color.
 - b. Thickness of anodic coating shall be tested in accordance with ASTM B244 and sealed to pass modified die stain test ASTM B136.
 - c. Color: As selected for architect from Fry Reglet's color selection.
 - d. Color anodized finish is for interior use only.
4. Special Order Color Anodized Finish
 - a. Coated with impregnated color.
 - b. Thickness of anodic coating shall be tested in accordance with ASTM B244 and sealed to pass modified die stain test ASTM B136.
 - c. Color: Where possible, color to be matched to customer provided sample.
 - d. Color anodized finish is for interior use only.

2.07 ADHESIVES AND FASTENERS

- A. Adhesives: Type suitable for intended purpose, complying with applicable air quality regulations.
- B. Fasteners: Of size and type to suit application; matching finish in concealed locations and matching finish in exposed locations.

2.08 WOOD-TREATMENT PROCESSES

- A. Fire Retardant Treatment (FR-S Type) for Lumber: Chemically treated and pressure impregnated; capable of providing flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.

2.09 SHOP TREATMENT OF WOOD MATERIALS

- A. Shop pressure treat wood materials requiring UL fire rating to concealed wood blocking.
- B. Provide UL approved identification on fire-retardant treated material.
- C. Deliver fire-retardant treated materials cut to required sizes. Minimize field cutting.

2.10 FABRICATION

- A. Shop prepare and identify panels for grain matching during site erection.
- B. Prepare panels for delivery to site, permitting passage through building openings.
- C. Finish exposed edges of panels as specified by grade requirements.
- D. When necessary to cut and fit on site, provide materials with ample allowance for cutting and scribing.

2.11 SHOP FINISHING

- A. Sand work smooth and set exposed nails and screws.
- B. Apply wood filler in exposed nail and screw indentations.

- C. Prime paint surfaces that will be in contact with cementitious materials.
- D. Back prime woodwork items to be field finished, prior to installation.

2.12 ACCESSORIES

- A. Lumber for Shimming, Blocking: Softwood lumber of compatible species.
- B. Wood Filler: Tinted to match surface finish color.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated on shop drawings.
- B. Verify adequacy of backing and support framing.
- C. Verify mechanical, electrical, and building items affecting work of this section are placed and ready to receive this work.

3.02 INSTALLATION

- A. Install work in accordance with AWMAC/WI (NAAWS) requirements for grade indicated.
- B. Do not begin installation until wood materials have been fully acclimated to interior conditions.
- C. Set and secure materials and components in place, plumb and level, using concealed fasteners wherever possible.
- D. Where necessary to cut and fit on site, scribe work abutting other components. Do not use additional overlay trim to conceal gaps.
- E. Coordinate the installation of firestopping behind paneling.
- F. Set exposed fasteners, fill with wood filler, and finish to match panel finish.

3.03 PREPARATION FOR FIELD FINISHING

- A. Set exposed fasteners. Apply wood filler in exposed fastener indentations. Sand work smooth.

3.04 TOLERANCES

- A. Maximum Variation from True Position: 1/16 inch.
- B. Maximum Offset from True Alignment with Abutting Materials: 1/32 inch.

END OF SECTION

SECTION 06 83 16 FIBERGLASS REINFORCED PANELING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Glass fiber reinforced plastic panels, FRP-1.
- B. Trim.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics; 2023, with Editorial Revision.
- B. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.
- C. ASTM D5319 - Standard Specification for Glass-Fiber Reinforced Polyester Wall and Ceiling Panels; 2022.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- E. FDA Food Code - Chapter 6 - Physical Facilities; Current Edition.
- F. ISO 846 - Plastics - Evaluation of the Action of Microorganisms; 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store panels flat, indoors, on a clean, dry surface. Remove packaging and allow panels to acclimate to room temperature for 48 hours prior to installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product: Standard FRP as manufactured by Marlite, or approved equal.
- B. Fiberglass Reinforced Plastic Panels:
 - 1. Crane Composites, Inc: www.cranecomposites.com.
 - 2. Marlite: Standard FRP: www.marlite.com.
 - 3. Nudo: www.nudo.com.
 - 4. Panolam Industries International, Inc: www.panolam.com/#sle.

5. Parkland Performance; Plas-Tex PolyWall; www.parklandplastics.com.
6. Substitutions: See Section 01 6000 - Product Requirements.

2.02 PANEL SYSTEMS

A. Wall Panels:

1. Panel Size: 4 by 8 feet.
2. Panel Thickness: 0.075 inch.
3. Surface Design: Smooth.
4. Color: White.
5. Attachment Method: Adhesive only, with trim and sealant in joints.

2.03 MATERIALS

A. Panels: Fiberglass reinforced plastic (FRP), complying with ASTM D5319.

1. Surface Burning Characteristics: Maximum flame spread index of 25 and smoke developed index of 450; when system tested in accordance with ASTM E84.
2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
3. Impact Strength: Greater than 6 ft lb force per inch, when tested in accordance with ASTM D256.
4. Surface Characteristics and Cleanability: Provide products that are smooth, durable, and easily cleanable, in compliance with FDA Food Code, Chapter 6 - Physical Facilities.
5. Biological Resistance: Rating of 0, when tested in accordance with ISO 846.

B. Trim: Aluminum; color coordinating with panel.

C. Adhesive: Type recommended by panel manufacturer.

D. Sealant: Type recommended by panel manufacturer; white.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions and substrate flatness before starting work.
- B. Verify that substrate conditions are ready to receive the work of this section.

3.02 INSTALLATION - WALLS

- A. Install panels in accordance with manufacturer's instructions.
- B. Cut and drill panels with carbide tipped saw blades, drill bits, or snips.
- C. Apply adhesive to the back side of the panel using trowel as recommended by adhesive manufacturer.
- D. Apply panels to wall with seams plumb and pattern aligned with adjoining panels.
- E. Install panels with manufacturer's recommended gap for panel field and corner joints.
- F. Place trim on panel before fastening edges, as required.
- G. Fill channels in trim with sealant before attaching to panel.
- H. Install trim with adhesive and screws or nails, as required.
- I. Seal gaps at floor, ceiling, and between panels with applicable sealant to prevent moisture intrusion.

- J. Remove excess sealant after paneling is installed and prior to curing.

END OF SECTION

SECTION 07 19 00 WATER REPELLENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water repellents applied to exterior, masonry, stone, and concrete surfaces.
- B. Pressure washing.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 96 23 - Graffiti-Resistant Coatings.

1.03 REFERENCE STANDARDS

- A. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023.
- B. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and District.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide product description, details of tests performed, limitations, and chemical composition.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Water Repellent Material: Two gallons of type installed.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience

- C. District reserves the right to provide continuous independent inspection of surface preparation and application of water repellent.

1.07 MOCK-UPS

- A. Prepare representative surface 36 by 36 inches in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
- B. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.
- C. Locate where directed.
- D. Mock-up may remain as part of work.

1.08 FIELD CONDITIONS

- A. Protect liquid materials from freezing.
- B. Do not apply water repellent when ambient temperature is lower than 50 degrees F or higher than 100 degrees F.
- C. Do not apply water repellents when wind velocity is higher than 10 mph.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Final Inspection.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Silane, Siloxane, Silane-Siloxane Blend, and Siliconate Water Repellents:
 - 1. Basis of Design Product: Sure Klean® Weather Seal Blok-Guard® & Graffiti Control II as manufactured by PROSOCO, Inc, or approved equal.
 - 2. BASF Construction Chemicals: www.buildingsystems.basf.com/#sle.
 - 3. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - 4. Evonik Corporation; Protectosil CHEM-TRETE BSM 400: www.evonik.com/#sle.
 - 5. Euclid Chemical Company; Product Tamms Chemstop, WB6 and WB11: www.euclidchemical.com.
 - 6. MonoPole Inc.: Aquaseal ME12: www.monopoleinc.com.
 - 7. PROSOCO, Inc: Siloxane WB Concentrate: www.prosoco.com/#sle.
 - 8. QUIKRETE Companies: www.quikrete.com/#sle.
 - 9. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - 10. Rainguard Products Co.; Product Blok-Lok 100% Penetrating Sealer; www.rainguard.com.
 - 11. Sika; Sikagard 701 W: www.us.sika.com.
 - 12. Tnemec Company, Inc: www.tnemec.com/#sle.
 - 13. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Water Repellent: Non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing sealer, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Applications: Vertical surfaces and non-traffic horizontal surfaces.
 - 2. Number of Coats: Two.
 - 3. VOC Content: See Section 01 61 16.
 - 4. Moisture Absorption When Applied to Masonry: Five percent, maximum, when tested in accordance with ASTM C140/C140M using masonry sample completely coated with water repellent.
 - 5. Maintains dry appearance when wetted.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of water repellent.

3.02 PREPARATION

- A. Protection of Adjacent Work:
 - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
 - 2. Protect adjacent surfaces not intended to receive water repellent.
- B. Prepare surfaces to be coated as recommended by water repellent manufacturer for best results.
- C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
- D. Remove loose particles and foreign matter.
- E. Remove oil and foreign substances with a chemical solvent that will not affect water repellent.
- F. Pressure wash surfaces to be coated.
 - 1. Concrete: High pressure wash at 1,500 to 4,000 psi, at 6 to 12 inches from surface.
 - 2. Firm Masonry (Concrete Masonry Units, Brick, and Dense Stone): High pressure wash at 1,500 to 4,000 psi, at 6 to 12 inches from surface.
- G. Allow surfaces to dry completely to degree recommended by water repellent manufacturer before starting coating work.

3.03 APPLICATION

- A. Apply water repellent in accordance with manufacturer's instructions, using procedures and application methods recommended as producing the best results.
- B. Apply at rate recommended by manufacturer, continuously over entire surface.
- C. Apply two coats, minimum.
- D. Remove water repellent from unintended surfaces immediately by a method instructed by water repellent manufacturer.

- E. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

END OF SECTION

SECTION 07 21 00 THERMAL INSULATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Batt insulation in exterior wall construction.
- B. Batt insulation for filling perimeter window and door shim spaces and crevices in exterior wall and roof.
- C. Batt insulation for acoustic applications in interior walls.

1.02 RELATED REQUIREMENTS

- A. Section 07 27 00 - Air Barriers: Separate air barrier materials.

1.03 DEFINITIONS

- A. Mineral Fiber Material Composition: Insulation referred to as mineral fiber block, board, and blanket insulation is composed of fibers from mineral based substances such as rock, slag, or glass and processed from the molten state into fibrous form.
 - 1. Based on type of insulation substance, the material will be referred to as a mineral fiber when having a rock or slag base, and glass fiber with a glass or silica sand base, also considered a mineral.
 - 2. Insulation blankets are flexible units consisting of felted, bonded, or unbonded fibers formed into rolls or flat cut pieces referred to as batts; rolls are simply longer versions of batts.
 - 3. For additional information about mineral fiber and the various classification types, refer to the following reference standards; ASTM C553, ASTM C612, ASTM C665, and ASTM C726.

1.04 REFERENCE STANDARDS

- A. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2013 (Reapproved 2019).
- B. ASTM C578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation; 2023.
- C. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2014 (Reapproved 2019).
- D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2023.
- E. ASTM C726 - Standard Specification for Mineral Wool Roof Insulation Board; 2017.
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- H. ASTM E136 - Standard Test Method for Assessing Combustibility of Materials Using a Vertical Tube Furnace at 750 Degrees C; 2024.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
 - 1. Manufacturer and product identification for each product specified, including R-Value and fire resistance and surface burning characteristics specified herein.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Compliance Certification: Upon completion of installation of building envelope insulation, a card certifying compliance with requirements of California Code of Regulations (CCR) Title 24 for installation of insulation shall be completed, executed and delivered to local building officials, and one copy conspicuously posted at Project site.
- E. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.06 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Fire Performance Characteristics: Where insulation is used within a fire rated wall assembly, provide insulation materials which are identical to those whose fire performance characteristics, as listed for each material or assembly of which insulation is a part, have been determined by testing, in accordance with methods specified below, by UL or other testing and inspecting agency acceptable to State Fire Marshal.
 - 1. Surface Burning Characteristics: ASTM E84.
 - a. Class A: Maximum flame-spread 0-25 and smoke developed of 0-450.
 - b. Class B: Maximum flame-spread 26-75 and smoke developed of 0-450.
 - c. Class C: Maximum flame-spread 76-200 and smoke developed of 0-450.
 - 2. Fire Resistance Ratings: ASTM E119.
 - 3. Combustibility: ASTM E136.
- B. Comply with Chapter 12-13 Standards for Insulating Materials, California Reference Standards Code (Part 12, Title 24, CCR) as published by Department of Consumer Affairs, Bureau of Home Furnishings and Thermal Insulation.
- C. Comply with California Energy Code:
 - 1. Section 110.8(a): Installed insulating material shall have been certified by the manufacturer to comply with the California Code of Regulations, Title 24, Part 12, Chapters 12-13, Article 3, "Standards for Insulating Material.
 - 2. Section 110.8(c): All Insulating Materials shall be installed in compliance with the flame spread rating and smoke density requirements of CBC Chapters 7 and 26.
 - 3. Section 120.7(b) item 7: The opaque portions of framed demising walls in nonresidential buildings shall be insulated to meet a u-factor of:
 - a. Metal Framed Walls: Not greater than 0.151 (R-6 minimum).

- D. Certificate: As required by the California Building Code (CBC), Title 24, post a certificate containing the building permit number and the insulation manufacturer's name, material identification and R-value and stating that the insulation has been installed in accordance with the plans and specifications.
- E. Performance: Materials shall conform to Section 720, California Building Code.

2.02 APPLICATIONS

- A. Insulation in Wood Framed Walls: Batt insulation with no vapor retarder.
- B. Acoustic Insulation in Wood Framed Interior Walls: Batt insulation with no vapor retarder.
- C. Insulation in Wood Framed Ceiling Structure: Batt insulation with no vapor retarder.

2.03 MINERAL FIBER BLANKET INSULATION MATERIALS

- A. Flexible Glass Fiber Blanket Thermal Insulation: Preformed insulation, complying with ASTM C665; friction fit.
 - 1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 3. Combustibility: Non-combustible, when tested in accordance with ASTM E136, except for facing, if any.
 - 4. Formaldehyde Content: Zero.
 - 5. Exterior Walls: Two layers.
 - a. Thermal Resistance: Each R-value of 15. Total R-30
 - b. Thickness: Each 3-1/2 inch.
 - 6. Underside of Roof:
 - a. Thermal Resistance: R-value of 30.
 - b. Thickness: 10-1/4 inch.
 - 7. Facing: Unfaced.
 - 8. Products:
 - a. CertainTeed Corporation: www.certainteed.com/#sle.
 - b. Johns Manville: www.jm.com/#sle.
 - c. Knauf Insulation: www.knauf.com.
 - d. Owens Corning Corporation: www.ocbuildingspec.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Mineral Wool Blanket Thermal Insulation: Flexible or semi-rigid preformed insulation, complying with ASTM C665.
 - 1. Typical at interior walls, see section 09 21 16 - Gypsum Board Assemblies.
 - 2. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 - 3. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 - 4. Products:
 - a. Johns Manville; MinWool Sound Attenuation Fire Batts: www.jm.com/#sle.
 - b. ROCKWOOL; COMFORTBATT: www.rockwool.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Wire Mesh: Galvanized steel, hexagonal wire mesh.
- B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.02 BATT INSTALLATION

- A. Install insulation and vapor retarder in accordance with manufacturer's instructions.
- B. Install in exterior wall spaces without gaps or voids.
- C. Trim insulation neatly to fit spaces. Insulate miscellaneous gaps and voids.
- D. Fit insulation tightly in cavities and tightly to exterior side of mechanical and electrical services within the plane of the insulation.

3.03 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

3.04 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

SECTION 07 25 00 WEATHER BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water-resistive barriers, two layers under exterior plaster over air barrier/weather barrier.

1.02 RELATED REQUIREMENTS

- A. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- B. Section 07 27 00 - Air Barriers: Air barriers sheet and fluid applied flashing.

1.03 DEFINITIONS

- A. Weather Barriers: Materials or assemblies forming water-resistive barriers, air barriers, vapor retarders, or combination of one or more assemblies.
- B. Water-Resistive Barriers: Materials or assemblies installed behind exterior wall coverings; designed to prevent liquid water from further penetration into exterior wall assembly.

1.04 REFERENCE STANDARDS

- A. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- B. AAMA 713 - Voluntary Test Method To Determine Chemical Compatibility of Sealants & Self-Adhered Flashing; 2008.
- C. ASTM C719 - Standard Test Method for Adhesion and Cohesion of Elastomeric Joint Sealants Under Cyclic Movement (Hockman Cycle); 2022.
- D. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- E. ASTM D226/D226M - Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing; 2017 (Reapproved 2023).
- F. ASTM D779 - Standard Test Method for Determining the Water Vapor Resistance of Sheet Materials in Contact with Liquid Water by the Dry Indicator Method; 2016.
- G. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- H. ASTM D3960 - Standard Practice for Determining Volatile Organic Compound (VOC) Content of Paints and Related Coatings; 2005 (Reapproved 2018).
- I. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- J. ASTM E2273 - Standard Test Method for Determining the Drainage Efficiency of Exterior Insulation and Finish Systems (EIFS) Clad Wall Assemblies; 2018.
- K. ASTM E2556/E2556M - Standard Specification for Vapor Permeable Flexible Sheet Water-Resistive Barriers Intended for Mechanical Attachment; 2010 (Reapproved 2016).
- L. ICC-ES AC308 - Acceptance Criteria for Water-Resistive Barriers; 2016, with Editorial Revision (2021).

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.

1.06 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Construct weather barrier mock-up, 12 feet long by 8 feet wide, indicating complete assembly with two layers under exterior plaster over air barrier..
- C. Locate where directed.
- D. Mock-up may remain as part of work.

1.07 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 WATER-RESISTIVE BARRIERS

- A. Description: Materials installed behind exterior wall coverings; designed to prevent liquid water from further penetration into exterior wall assembly. Primary materials include mechanically applied sheets; accessory materials include flashings and seam tapes.
- B. Asphalt Felt: ASTM D226/D226M, Type I, No.15 asphalt felt.
- C. Building Paper: Asphalt-saturated kraft Grade D type sheathing paper complying with ICC-ES AC38.
 - 1. Water Resistance: At least 60 minutes when tested in accordance with ASTM D779.
 - 2. Water Vapor Permeance: 29 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
 - 3. Products:
 - a. Henry Company; Super Jumbo Tex 60 Minute: www.henry.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Optional: Building Paper with Embossed Drainage Layer: Asphalt-saturated kraft Grade D type sheathing paper with embossed spunbond polypropylene fabric and barrier layer complying with ICC-ES AC38, CBC 1403.2, CBC 2510.6.1, and ASTM E2556/E2556M Type II.
 - 1. Water Resistance: At least 120 minutes when tested in accordance with ASTM D779.
 - 2. Water Vapor Permeance: 7.6 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
 - 3. Drainage Efficiency: Greater than 95 percent in accordance with ASTM E2273.
 - 4. Products:
 - a. Henry Company; HydroTex: www.henry.com/#sle.
 - 1) ICC ESR-1027 and ESR-3791.

- b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- 5. Weather-Resistive Barrier Seam Tape: Pressure sensitive tape as recommended by membrane manufacturer.
 - a. Types: Sheathing Tape: Henry – Sheathing Tape, or equal.
 - b. Roll Dimensions: 1-7/8" x 55 yards.
 - c. Adhesive Type: Acrylic.
- 6. Sealant: One component, moisture curing, non-sag, gun-grade elastomeric polymer for use as a sealant or liquid applied flashing.
 - a. Types: Sealant: Henry – Moistop® Sealant, or equal.
 - b. Referenced Standards: Must meet ASTM C920.
 - c. Movement Capability: ±25%; ASTM C719.
 - d. Max VOC: 9 g/L; ASTM D3960.
 - e. Compatibility: Chemically compatible with flexible flashing; AAMA 713.

2.02 ACCESSORIES

- A. Seal and Perimeter Tapes: As recommended by water-resistive barrier manufacturer.
- B. Flashings and Sealants: As recommended by water-resistive barrier manufacturer for application.
- C. Metal Flashings: See Section 07 62 00.
- D. Flexible Flashing: Self-adhering sheet flashing complying with ASTM D1970/D1970M; waive slip resistance requirement if not installed on roof.
 - 1. Width: 4 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
 - 3. Products:
 - a. DuPont de Nemours, Inc; FlexWrap: www.dupont.com/building/#sle.
 - b. Henry Company; FortiFlash: www.henry.com/#sle.
 - c. W. R. Meadows, Inc; Air-Shield Butyl Flashing: www.wrmeadows.com/#sle.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
- E. Preformed Transition Membrane: Semi-rigid silicone or polyester composition, tapered edges, and tear resistant.
 - 1. Products:
 - a. Dow; DOWSIL Silicone Transition Strip and System: www.dow.com/en-us/#sle.
 - b. Henry Company; Moistop Corner Shield: www.henry.com/#sle.
 - c. Momentive Performance Materials, Inc/GE Silicones; RF100 Reinforcing Fabric: www.siliconeforbuilding.com/#sle.
 - d. Pecora Corporation: www.pecora.com/#sle.
 - e. Tremco Commercial Sealants & Waterproofing; ProGlaze ETA System 1: www.tremcosealants.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FASTENERS

- A. Fasteners for Attaching Water-Resistive Barriers to Substrates: As recommended by barrier manufacturer for application.
- B. Self-Sealing Washers: Solid plastic, 2 inch diameter washers; seals building-wrap air barriers against air penetration.
 - 1. Products:
 - a. TruFast Walls, a Division of Altenloh, Brinck & Co. US, Inc; Thermal-Grip Flat Washer: www.trufastwalls.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions comply with requirements of this section.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Install continuous water-resistive barriers where indicated on drawings, with sheets lapped to shed water.
 - 1. At Plaster: Install two layers building paper under lath over plastic sheet per Section 07 27 00 - Air Barriers.
 - 2. Not required at metal panels.
- C. Apply sealants within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Mechanically Fastened Sheets:
 - 1. Install sheets in shingle fashion to shed water; align horizontally.
 - 2. Overlap seams as recommended by manufacturer, 6 inches, minimum.
 - 3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches, minimum.
 - 4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
 - 5. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
 - 6. Where stud framing rests on concrete or masonry substrate, extend lower edge of barrier sheets at least 4 inches below bottom of framing and seal to substrate with sealant or approved mounting tape.
 - 7. Install water-resistive barrier over jamb flashings.

8. Install head flashings under water-resistive barrier.
 9. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.
- E. Openings and Penetrations in Exterior Water-Resistive Barriers:
1. Install flashing over sills, covering entire sill framing member, and extend at least 5 inches onto water-resistive barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 2. At openings filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
 3. At openings filled with nonflanged frames, seal water-resistive barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
 4. At head of openings, install flashing under water-resistive barrier extending at least 2 inches beyond face of jambs; seal water-resistive barrier to flashing.
 5. At interior face of openings, seal gaps between window and door frames and rough framing using appropriate joint sealant over backer rod.
 6. Service and Other Penetrations: Form flashing around penetrating items and seal to surface of water-resistive barrier.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. District's Inspection and Testing: Cooperate with District's testing agency.
 1. Allow access to work areas and staging.
 2. Notify District's testing agency in writing of schedule for work of this section to allow sufficient time for testing and inspection.
 3. Do not cover work of this section until testing and inspection is accepted.
- C. Do not cover installed water-resistive barriers until required inspections have been completed.
- D. Obtain approval of installation procedures from water-resistive barrier manufacturer based on a mock-up installed in place, prior to proceeding with remainder of installation.
- E. Envelope Water-Spray Test by Contractor: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
 1. Perform a minimum of two tests in each area as directed by Architect.
 2. Conduct tests in each area prior to 35 percent and 70 percent completion of this work.
 3. Testing: Installer to water test all weather barriers, storefront, windows, glazing, and door openings, in the presence of the Project Inspector (IOR) and Construction Manager by spraying with hose heavily for 5 minutes. Repair all leaks discovered by testing procedures and repeat test until leak-free performance is achieved.
- F. Take digital photographs of each portion of installation prior to covering up weather barriers.

3.05 PROTECTION

- A. Do not leave paper- or felt-based barriers exposed to weather for longer than one week.

END OF SECTION

SECTION 07 27 00 AIR BARRIERS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Air barriers at all exterior wall surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Building paper under plaster applications and testing requirements.
- B. Section 07 62 00 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with air barriers.

1.03 DEFINITIONS

- A. Air Barrier: Airtight barrier made of material that is virtually air impermeable but water vapor permeable, both to amount as specified, with sealed seams and sealed joints to adjacent surfaces.

1.04 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- B. ASTM D751 - Standard Test Methods for Coated Fabrics; 2019.
- C. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2017).
- D. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- F. ASTM E96/E96M - Standard Test Methods for Gravimetric Determination of Water Vapor Transmission Rate of Materials; 2023.
- G. ASTM E2178 - Standard Test Method for Determining Air Leakage Rate and Calculation of Air Permeance of Building Materials; 2021a.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on material characteristics, performance criteria, and limitations.
- C. Shop Drawings: Provide drawings of special joint conditions.
- D. Manufacturer's Installation Instructions: Indicate preparation, installation methods, and storage and handling criteria.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Testing agency qualification statement.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- B. Manufacturer Qualification: Use evaluated materials from a single manufacturer regularly engaged in air barrier material manufacture, and use secondary materials approved in writing by primary material manufacturer.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Construct air barrier mock-up, 12 feet long by 8 feet wide, indicating complete assembly under exterior cladding with two layers under exterior plaster over air barrier..
- C. Locate where directed.
- D. Mock-up may remain as part of work.

1.08 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by materials manufacturers before, during, and after installation.

PART 2 PRODUCTS

2.01 AIR BARRIER MATERIALS (AIR IMPERMEABLE AND WATER VAPOR PERMEABLE)

- A. Air Barrier Sheet, Mechanically Fastened:
 - 1. Thickness: 3.6 mils, 0.0036 inch.
 - 2. Air Permeance: 0.004 cfm/sq ft, maximum, when tested in accordance with ASTM E2178.
 - 3. Water Vapor Permeance: 10 perms, minimum, when tested in accordance with ASTM E96/E96M using Procedure A - Desiccant Method, at 73.4 degrees F.
 - 4. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 90 days of weather exposure.
 - 5. Surface Burning Characteristics: Flame spread index of 25 or less, and smoke developed index of 50 or less, Class A, when tested in accordance with ASTM E84.
 - 6. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2-1/2 inches wide, compatible with sheet material; unless otherwise indicated.
 - 7. Products:
 - a. Certainteed, Inc.; CertaWrap Weather-Protection Membrane: www.certainteed.com.
 - b. DuPont de Nemours, Inc; Tyvek CommercialWrap D with FlexWrap NF, StraightFlash, StraightFlash VF, Tyvek Wrap Caps, and Tyvek Tape: building.dupont.com/#sle.
 - c. Fiberweb, Inc; Typar MetroWrap: www.typar.com/#sle.
 - d. Henry Company; WeatherSmart Commercial: www.henry.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.02 ACCESSORIES

- A. Sealants, Tapes, and Accessories for Sealing Air Barrier and Adjacent Substrates: As indicated or in compliance with air barrier manufacturer's installation instructions.
- B. Sealant for Cracks and Joints In Substrates: Resilient elastomeric joint sealant compatible with substrate and air barrier materials.
 - 1. Application: Apply at 30 to 40 mil, 0.030 to 0.040 inch, nominal thickness.
 - 2. Color: Green.
 - 3. Elongation: 1,300 percent, measured in accordance with ASTM D412.
 - 4. Peel Adhesion: 28 lb/inch, minimum, when tested in accordance with ASTM D903.
 - 5. Hydrostatic Head Pressure: Resists head pressure of 57 feet, maximum, when tested in accordance with ASTM D751.
 - 6. Products:
 - a. Karnak Corporation; 323 K-NRG Gap Seal FR: www.karnakcorp.com/#sle.
 - b. Rubber Polymer Company; Rub-R-Wall Mastic: www.rpcinfo.com/#sle.
 - c. TYPAR; TYPAR HD Heavy-Duty Sealant: www.typar.com/#sle.
 - d. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Flexible Flashing: Self-adhesive sheet flashing complying with ASTM D1970/D1970M, except slip resistance requirement waived if not installed on roof.
 - 1. Width: 4 inches.
 - 2. Ultraviolet (UV) and Weathering Resistance: Approved by manufacturer for up to 30 days of weather exposure.
 - 3. Products:
 - a. DuPont de Nemours, Inc; DuPont FlexWrap: www.dupont.com/building/#sle.
 - b. DuPont de Nemours, Inc; DuPont StraightFlash: www.dupont.com/building/#sle.
 - c. DuPont de Nemours, Inc; DuPont VersaFlange: www.dupont.com/building/#sle.
 - d. Henry Company; FortiFlash: www.henry.com/#sle.
 - e. Henry Company; FortiFlex Butyl: www.henry.com/#sle.
 - f. Henry Company; FortiFlash Butyl: www.henry.com/#sle.
 - g. TYPAR; TYPAR All-Temperature Flashing: www.typar.com/#sle.
 - h. TYPAR; TYPAR Butyl Flashing: www.typar.com/#sle.
 - i. TYPAR; TYPAR Flexible Flashing: www.typar.com/#sle.
 - j. W. R. Meadows, Inc; Air-Shield Butyl Flashing: www.wrmeadows.com/#sle.
 - k. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Liquid Flashing: One part, fast curing, nonsag, gun grade, trowelable.
 - 1. Products:
 - a. Dow; DOWSIL 778 Silicone Liquid Flashing: www.dow.com/en-us/#sle.
 - b. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/en-us/#sle.
 - c. Momentive Performance Materials, Inc/GE Silicones; Elemax 5000 Liquid-Applied Flashing: www.siliconeforbuilding.com/#sle.
 - d. Parex USA, Inc; Parex USA WeatherTECH with WeatherFlash: www.parexusa.com/#sle.

- e. Polyglass USA, Inc: www.polyglass.us/#sle.
 - f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Thinners and Cleaners: As recommended by material manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and conditions are ready for work of this section.
- B. Where existing conditions are responsibility of another installer, notify Architect of unsatisfactory conditions.
- C. Do not proceed with this work until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.
- B. Clean and prime substrate surfaces to receive adhesives and sealants in accordance with manufacturer's installation instructions.

3.03 INSTALLATION

- A. Install materials in accordance with manufacturer's installation instructions.
- B. Air Barriers: Install continuous airtight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Apply sealants and adhesives within recommended temperature range in accordance with manufacturer's installation instructions.
- D. Mechanically Fastened Sheets - On Exterior:
 - 1. Install sheets shingle fashion to shed water, with seams generally horizontal.
 - 2. Overlap seams as recommended by manufacturer, 6 inches, minimum.
 - 3. Overlap at outside and inside corners as recommended by manufacturer, 12 inches, minimum.
 - 4. Attach to framed construction with fasteners extending through sheathing into framing, and space fasteners at 12 to 18 inches on center along each framing member supporting sheathing.
 - 5. For applications indicated to be airtight, seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners as recommended by manufacturer.
 - 6. Where stud framing rests on concrete or masonry substrate, extend lower edge of air barrier sheet at least 4 inches below bottom of framing and seal to substrate with sealant or approved mounting tape.
 - 7. Install air barrier underneath jamb flashings.
 - 8. At framed openings with frames having nailing flanges, extend sheet into opening and over flanges; at head of opening, seal sheet over flange and flashing.
- E. Openings and Penetrations in Exterior Air Barriers:
 - 1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto air barrier and at least 6 inches up jambs; mechanically fasten stretched edges.

2. At openings with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with sealing tape at least 4 inches wide; do not seal sill flange.
3. At openings with nonflanged frames, seal air barrier to each side of framing at opening using flashing at least 9 inches wide, and covering entire depth of framing.
4. At head of openings, install flashing under air barrier extending at least 2 inches beyond face of jambs; seal air barrier to flashing.
5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
6. Service and Other Penetrations: Form flashing around penetrating item and seal to air barrier surface.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. District will provide testing services, and Contractor to provide temporary construction and materials for testing.
- C. Coordination of ABAA Tests and Inspections:
 1. Provide testing and inspection required by ABAA QAP.
 2. Notify ABAA in writing of schedule for air barrier work, and allow adequate time for testing and inspection.
 3. Cooperate with ABAA testing agency.
 4. Allow access to air barrier work areas and staging.
 5. Do not cover air barrier work until tested, inspected, and accepted.
- D. Do not cover installed air barriers until required inspections have been completed.
- E. Take digital photographs of each portion of installation prior to covering up air barriers.

3.05 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

SECTION 07 52 00
MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Modified bituminous roofing membrane, conventional application.
 - 1. Self-Adhered 2 Ply Roofing (StressPly SA FR Mineral).
- B. Insulation, flat and tapered.
- C. Cover boards.
- D. Roofing cant strips, roofing expansion joints, and walkway pads.
 - 1. Edge Treatment and Roof Penetration Flashings.
- E. Building Identification on roof.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Wood nailers and curbs.
- B. Section 06 10 00 - Rough Carpentry: Wood cant strips.
- C. Section 07 62 00 - Sheet Metal Flashing and Trim: Counterflashings, reglets.
- D. Section 07 72 00 - Roof Accessories: Roof-mounted units.
- E. Divisions 21, 22, & 23 - Mechanical: Piping penetrations, Plumbing vents and internal roof drains.
- F. Divisions 26, 27, & 28 - Electrical: Conduit penetrations.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing; 2017.
- C. ASTM C1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2023a.
- D. ASTM D1079 - Standard Terminology Relating to Roofing and Waterproofing; 2020.
- E. ASTM D41/D41M - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing; 2011 (Reapproved 2023).
- F. ASTM D93 - Standard Test Methods for Flash Point by Pensky-Martens Closed Cup Tester; 2020.
- G. ASTM D312/D312M - Standard Specification for Asphalt Used in Roofing; 2016a (Reapproved 2023).
- H. ASTM D4479/D4479M - Standard Specification for Asphalt Roof Coatings - Asbestos-Free; 2007 (Reapproved 2018).
- I. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- J. ASTM E108 - Standard Test Methods for Fire Tests of Roof Coverings; 2020a.

- K. ASTM D4897/D4897M - Standard Specification for Asphalt-Coated Glass-Fiber Venting Base Sheet Used in Roofing; 2016 (Reapproved 2023).
- L. ASTM D5147/D5147M - Standard Test Methods for Sampling and Testing Modified Bituminous Sheet Material; 2018.
- M. ASTM D6162/D6162M - Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements; 2021.
- N. ASTM E1980 - Standard Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces; 2011 (Reapproved 2019).
- O. FM DS 1-28 - Wind Design; 2015, with Editorial Revision (2024).
- P. NRCA (RM) - The NRCA Roofing Manual; 2024.
- Q. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.
- R. Western States Roofing Contractors Association (WSRCA): Published details and recommendations.
- S. UL (DIR) - Online Certifications Directory; Current Edition.
- T. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 DEFINITIONS

- A. Roofing Terminology: Refer to ASTM D1079 and glossary of NRCA (RM) for definition of terms related to roofing work in this Section.
- B. Cold Process Built Up Roofing – An asbestos free formulation of asphalt, solvent, thixotrope, mineral stabilizer and reinforcing fibers used as an interply adhesive.
- C. Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," before multiplication by a safety factor.
- D. Factored Design Uplift Pressure: The uplift pressure, calculated according to procedures in SPRI's "Wind Load Design Guide for Fully Adhered and Mechanically Fastened Roofing Systems," after multiplication by a safety factor.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of associated flashings and counterflashings installed by other sections.
- B. Preinstallation Meeting: Convene minimum two weeks before starting work of this section.
 - 1. Review preparation and installation procedures and coordinating and scheduling required with related work.
 - 2. Notification: Two weeks prior to pre-application conference, inform District, Construction Manager, and Architect of scheduled roofing beginning and completion dates, such that District may arrange for independent inspection of roofing Work, and presence of independent testing and inspection agency at pre-application conference.
 - 3. Attendance: Require attendance by Contractor's superintendent and other supervisory and quality control personnel having responsibility for roofing, supervisory personnel of roofing applicator and, if required for warranty provisions, representative of roofing products manufacturer.
 - a. DSA, Construction Manager, independent testing agency, independent roofing inspector, Architect, and insurer for Architect; if authorized by District, will attend.

- b. Require attendance of installers of each component of related Work, including deck or substrate construction, rigid insulation, metal flashing, rooftop equipment, penetrations of roof deck, and other Work integral with or adjacent to roofing may attend.
- c. If required, attendance shall include authorities having jurisdiction. Contractor shall verify requirement with authorities having jurisdiction and arrange for attendance.
- d. Agenda:
 - 1) Meeting purpose is to review Drawings and Specifications for suitability for application of roofing system.
 - 2) Review application procedures and coordination required with related Work. Discuss changes and deviations from Drawings and Specifications, if any, recommended or required.
 - 3) Walk roof areas to review and discuss substrate preparation including repair of unacceptable surfaces, roof drainage, penetrations, equipment curbs, and work performed by other trades, which require coordination with roofing system.
 - 4) Review contract document requirements and submittals for roofing system, including roofing schedule, inspection and testing, and environmental conditions. Identify which governing regulations or insurance requirements will affect roofing system installation.
 - 5) Discuss anticipated weather, as well as procedures for responding to unacceptable weather, including using temporary roofing. Temporary roofing, if necessary, will be added to scope of the Work by contract modification (change order or construction change directive), with acceptable adjustment in Contract Time and Contract Sum.
 - 6) Document discussions in writing, including actions required, and distribute copy of report to each meeting participant.
 - 7) Attendance by Construction Manager, independent testing agency, independent roofing inspector, Architect, and insurer for Architect, does not relieve the Contractor of sole responsibility for means, methods, techniques and sequence of construction, in accordance with provisions of the Conditions of the Contract.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturer's catalog data for membrane and bitumen materials, base flashing materials and surfacing.
 - 1. Sustainable Design Submittal: Include testing documentation of solar reflectance index.
- C. Shop Drawings: Indicate joint or termination detail conditions, conditions of interface with other materials, setting plan for tapered insulation, and mechanical fastener layout.
 - 1. Base flashings, cants, and membrane terminations.
 - 2. Tapered insulation, including slopes.
 - 3. Crickets, saddles, and tapered edge strips, including slopes.
- D. Samples: Submit two samples 6 x 6 inches in size illustrating granule surfaced sheet, colored coated sheet, and insulation.
- E. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.

1. Instructions and recommendations for application of roofing system, for each substrate and condition of the Project, with specific directions and recommendations for conditions of the Project for specified guarantee by manufacturer.
- F. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- G. Manufacturer's Field Reports: Indicate procedures followed, ambient temperatures, humidity, wind velocity during application, and supplementary instructions given.
 1. Provide a notarized letter stating that a full-time representative of the roofing manufacturer will perform the site inspections listed in this section.
- H. Manufacturer's qualification statement.
- I. Installer's qualification statement.
 1. Applicator's Certification: Written documentation that applicator is certified by roofing manufacturer to install roofing systems to be provided for the Project as specified in this Section.
- J. Testing firm's qualification statement.
- K. Warranty: Submit manufacturer warranty and ensure forms have been completed in District's name and registered with manufacturer.

1.07 QUALITY ASSURANCE

- A. Comply with Title 24 Part 2 - California Building Code Sections 1504 Performance Requirements, 1505 Fire Classification and 1507 Requirements for Roof Coverings; and Part 6 - California Energy Code requirements
- B. Contractor to review all roofing details prior to bid. Submittal of bid per contract documents shall be guarantee that roofing will be installed and warrantied as shown on contract documents. Any detail revisions initiated by roofing contractor or manufacturer will be implemented at contractor's cost.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
- D. Installer Qualifications: Company specializing in performing the work of this section with minimum five years documented experience, and approved by manufacturer.
 1. Field Supervision: Maintain a full-time Supervisor/Foreman on job site during all phases of roofing work while roofing work is in progress.
- E. District's Testing Firm Qualifications: Company specializing in performing work of the type specified and approved by manufacturer.
- F. Source Limitations: Obtain all components of roof system from a single manufacturer. Secondary products that are required shall be recommended and approved in writing by the roofing system Manufacturer. Upon request of the Architect or District, submit Manufacturer's written approval of secondary components in list form, signed by an authorized agent of the Manufacturer.
- G. Industry Standards:
 1. Work specified in this Section shall conform to manufacturer's product data and application instructions.
 2. Work shall also conform to the more stringent of recommended practices and details published in NRCA Roofing and Waterproofing Manual and Western States Roofing Contractors Association (WSRCA).
- H. Testing and Inspection:

1. District's independent inspection and testing agency will perform inspections and tests of roofing work.
2. Costs of this service will be paid for by District.
3. Contractor shall cooperate with independent testing and inspection agency.
4. Refer to general requirements specified in Section 01 40 00 - Quality Requirements and 01 45 33 - Code-Required Special Inspections.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Deliver materials in manufacturer's original containers, dry and undamaged, with seals and labels intact unless otherwise indicated.
- C. Store materials in weather protected environment, clear of ground and moisture; ballast materials may be stored outdoors.
- D. Ensure storage and staging of materials does not exceed static and dynamic load-bearing capacities of roof decking.
- E. All materials which are determined to be damaged by the Construction Manager or the manufacturer are to be removed from the job site and replaced at no cost to the District.

1.09 FIELD CONDITIONS

- A. Temporary Roofing: Provide temporary roof membrane if necessary to protect portions of the Work before final roofing can be installed.
 1. Remove temporary roofing before starting installation of final roofing system.
- B. Do not apply roofing membrane when environmental conditions are outside the ranges recommended by manufacturer.
- C. Do not apply roofing membrane during unsuitable weather.
- D. Do not apply roofing membrane when ambient temperature is below 40 degrees F.
- E. Do not apply roofing membrane to damp or frozen deck surface or when precipitation is expected or occurring.
- F. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed the same day.
- G. Schedule applications so that no partially completed sections of roof are left exposed at end of workday.
- H. Arrange work sequence to avoid use of newly constructed roofing as a walking surface or for equipment movement and storage.
 1. Where such access is absolutely required, the General Contractor or Construction Manager shall provide all necessary protection and barriers to segregate the work area and to prevent damage to adjacent areas.
 2. A substantial protection layer consisting of plywood over felt or plywood over insulation board shall be provided for all new and existing roof areas that receive rooftop traffic during construction.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective work within a 2-year period after Date of Substantial Completion.

1. Special Project Warranty: Submit roofing Installer's warranty, on warranty form in Section 01 78 00 - Closeout Submittals, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products.
2. Applicator/Roofing Contractor Warranty:
 - a. The Applicator shall supply the District with a separate two-year workmanship warranty.
 - b. In the event any work related to roofing, flashing, or associated metal is found to be within the Applicator warranty term, defective or otherwise not in accordance with the Contract Documents, the Applicator shall repair that defect at no cost to the District.
 - c. The Applicator's warranty obligation shall run directly to the District, and a copy shall be sent to the manufacturer.
- C. Provide thirty (30) year, No Dollar Limit (NDL), manufacturer's non-prorated material and labor warranty to cover failure to prevent penetration of water.
 1. Guarantee shall be in addition to, and not a limitation of, other rights the District may have under the Contract Documents.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Modified Bituminous Membrane Roofing:
 1. Basis of Design Product: 3-Ply Hot Applied System. as manufactured by Garland Company, or approved equal. ICC ESR-3460
Local Representative:
Jason Moronnolte
(661) 889-0449
jmoronnolte@garlandco.com
 2. GAF: www.gaf.com/sle.
 3. Garland Company, Inc.: www.garlandco.com.
 4. Henry Co.; www.henry.com.
 5. Johns-Manville; www.specjm.com
 6. Tremco Roofing and Building Maintenance Division: www.tremcoroofing.com.
 7. Siplast: www.siplast.com.
 8. Soprema USA; www.soprema.us.
 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Insulation:
 1. Any insulation as part of the tested and warrantable roofing system membrane assembly.
 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SYSTEM DESIGN

- A. SBS Cold applied built-up roofing, installed over nailable plywood roof deck substrate, shall be provided as necessary for complete, weathertight installation conforming to actual conditions of new construction.
1. Assembly on nailable plywood roof deck: (from the top down)
 - a. Coat entire roof with Title 24 coating.
 - 1) Surface Coatings
 - (a) Pyramic Plus LO: applied at 2 gallons per 100 square feet
 - (b) Solex applied at 0.5 gallons per 100 square feet
 - b. Flashing Ply Adhesive: Flashing Bond.
 - c. Roofing Membrane
 - 1) Flashing Cap (Ply) Sheet: One ply bonded to the prepared substrate.
 - (a) StressPly SA FR Mineral.
 - 2) Flashing Base Ply: One ply bonded to the prepared substrate.
 - (a) HPR SA FR Base Sheet.
 - 3) Interply Adhesive: Use over approved cover boards or wood decks for base sheet only
 - (a) SA Primer.
 - 4) Modified Cap (Ply) Sheet: One ply bonded to the prepared substrate with self-adhesive.
 - (a) StressPly SA FR Mineral.
 - 5) Base (Ply) Sheet: One ply bonded to the prepared substrate with self-adhesive.
 - (a) HPR SA FR Base Sheet.
 - d. Rigid Cover Board: Mechanically attached per ASCE 7-16 wind uplift requirements to the prepared substrate.
 - 1) 1/2 inch DensDeck Prime Coverboard.
 - e. Insulation: Mechanically attached per ASCE 7-16 wind uplift requirements to the prepared substrate.
 - f. Roof Deck.
- B. Contract Drawings and Specifications:
1. Contract Drawings and Specifications are diagrammatic and of a general nature only.
 2. Materials manufacturer's specifications for roofing and related flashings shall govern Work as if set forth herein, except as specifically indicated or where requirements that are more stringent are specified or required by authorities having jurisdiction.
 3. All Work shall be completed as required to obtain specified warranty and guarantee.
- C. Design Review:
1. Contractor, roofing applicator and materials manufacturer shall review Drawings and Specifications for conformance with technical and warranty requirements.
 - a. Note any areas that water will not flow directly to the drains and report them with proposed adjustments to the Architect in writing before any roofing begins.
 - b. Proposed adjustments shall be at no additional cost to District.
 - c. Roofing contractor is responsible for correction of any ponding areas.

2. Provide from materials manufacturer written certification that selected roofing and flashing are proper, compatible and adequate for the Project and that conditions and details indicated and specified do not conflict with requirements and recommendations of manufacturer.

2.03 PERFORMANCE REQUIREMENTS

- A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.
- B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.
- C. Roofing System Design: Provide a roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE 7-16.
 1. Safety Factor: As required by code; minimum 2.0.
 2. Wind Analysis: See Design Criteria on Sheet S-0.1 of the Structural Drawings.
 - a. Basic wind speed $V = 101$ mph
 3. Wind Resistance Classification: Factory Mutual I-90, in accordance with FM DS 1-28.
- D. Roofing System shall be Energy Star Certified.

2.04 COLD APPLIED ROOFING - CONVENTIONAL APPLICATION

- A. Modified Bituminous Roofing: Two-ply membrane, plus cap sheet.
- B. Roofing Assembly Requirements:
 1. Solar Reflectance Index (SRI): Minimum of 64 based on three-year aged value; if three-year aged data is not available, minimum of 82 initial value.
 - a. Calculate SRI in accordance with ASTM E1980.
 - b. Field applied coating may be used to achieve specified SRI.
 2. Roofing System shall be Energy Star Certified.
 3. Solar Reflectance Index (SRI): 78, minimum, calculated in accordance with ASTM E1980, based on 3-year aged data.
 - a. Field applied coating may be used to achieve specified SRI.
 4. External Fire Exposure Classification: ASTM E108 Class A, UL (FRD) listed.
 5. Wind Resistance Classification: Factory Mutual 1-75, in accordance with FM DS 1-28.
 6. Insulation Thermal Resistance (R-Value): 3 per inch, minimum; provide insulation of thickness required.
 7. Surfacing: California Green Code (T24) compliant surfacing. Comply with California Title 24 Parts 6 and 11.
- C. Acceptable Insulation Types - Constant Thickness Application: Any type that meets requirements and is approved by membrane manufacturer for application.
 1. Single layer of polyisocyanurate board.
- D. Acceptable Insulation Types - Tapered Application: Any type that meets requirements and is approved by membrane manufacturer for application.
 1. Tapered polyisocyanurate board.

2.05 MEMBRANE AND SHEET MATERIALS

- A. Membrane System Cap Sheet: Polymer modified asphalt, reinforced with non-woven fabric; granule surfaced; with the following characteristics:
 - 1. Minimum Quality: ASTM D6162/D6162M Type III; styrene-butadiene-styrene (SBS) modified, glass fiber and polyester reinforced.
 - a. StressPly SA FR Mineral: 140 mil SBS (Styrene-Butadiene-Styrene) mineral surfaced self-adhered, rubber modified roofing membrane reinforced with a fiberglass and polyester composite scrim. Grade G.
 - 1) Tensile Strength, ASTM D5147/D5147M.
 - (a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 310 lbf/in XD 310 lbf/in
 - (b) 50 mm/min. @ 23 +/- 2 deg. C MD 54.25 kN/m XD 54.25 kN/m
 - 2) Tear Strength, ASTM D5147/D5147M.
 - (a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 500 lbf XD 500 lbf
 - (b) 50 mm/min. @ 23 +/- 2 deg. C MD 2224 N XD 2224 N
 - 3) Elongation at Maximum Tensile, ASTM D5147/D5147M.
 - (a) 2 in/min. @ 73.4 +/- 3.6 deg. F MD 3.5% XD 3.5%
 - (b) 50 mm/min. @ 23 +/- 2 deg. C MD 3.5% XD 3.5%
 - 4) Low Temperature Flexibility, ASTM D5147/D5147M, Passes -15 deg. F (-26 deg. C)
 - 2. Solar Reflectance: 0.75, minimum, initial, and 0.60, minimum, 3-year, certified by Cool Roof Rating Council.
 - a. Field applied coating may be used to achieve specified SRI.
 - b. Comply with Section 140.3, California Energy Code (T24, Part 6).
 - c. Comply with California Title 24 Parts 6 and 11.
 - 3. Thermal Emissivity: 0.75, minimum, initial, and 0.70, minimum, 3-year, certified by Cool Roof Rating Council.
 - a. Comply with Section 140.3, California Energy Code (T24, Part 6).
 - 4. Color: White.
 - B. Base Sheet: Asphalt-saturated and -coated, venting glass fiber felt; ASTM D4897/D4897M, Type II, Heavy-Duty.
 - C. Dry Sheathing Paper: Red rosin paper, unsaturated.
 - D. Flexible Flashing Material: Same material as membrane.
 - 1. Product: StressPly EUV, 115 mil, ASTM 6162, Type III manufactured by Garland.
 - 2. Base Flashing Ply: One (1) ply of a modified smooth sheet; 115 mil SBS and SIS rubberized sheet utilizing Kevlar fibers and a dual polyester and fiberglass combination reinforcement base sheet covered by an additional layer of modified bitumen membrane and set in bitumen. ASTM D6162/D6162M.

2.06 BITUMINOUS MATERIALS

- A. Bitumen: Asphalt, ASTM D312/D312M Type IV; for adhering insulation, use Type III.
- B. Flashing Ply Adhesive:
 - 1. Flashing Bond: Asphalt roofing mastic V.O.C. compliant, ASTM D4586/D4586M, Type II trowel grade flashing adhesive.

2. Non-Volatile Content ASTM D4479/D4479M 70 min.
3. Density ASTM D1475 8.3 lbs./gal. (1kg/l)
4. Flash Point ASTM D93 103 deg. F (39 deg. C)
- C. Asphalt Primer: ASTM D41/D41M, asphalt type.
- D. Cap Sheet Adhesive: Cold processed adhesive as required for manufacturers warranted system.
- E. Flashing Sheet Adhesive: Cold processed, vertical grade, flashing sheet adhesive as required for manufacturers warranted system.
- F. Asphalt Roof Cement: ASTM D4586/D4586M, Type II, asbestos-free.

2.07 COVER BOARDS

- A. Cover Boards: Glass-mat faced gypsum panels complying with ASTM C1177/C1177M.
 1. Thickness: 1/2 inch, fire-resistant.
 2. Products:
 - a. Georgia-Pacific; DensDeck Prime Roof Boards with EONIC Technology: www.densdeck.com/#sle.
 - b. USG Corporation; Securock Ultralight Glass-Mat Roof Board: www.usg.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.

2.08 INSULATION

- A. Polyisocyanurate (ISO) Board Insulation: Rigid cellular foam complying with ASTM C1289.
 1. Classifications:
 - a. Type II: Faced with either cellulosic facers or glass fiber mat facers on both major surfaces of the core foam.
 - 1) Class 1 - Faced with glass fiber reinforced cellulosic facers on both major surfaces of the core foam.
 - 2) Compressive Strength: Classes 1-2-3, Grade 3 - 25 psi (172 kPa), minimum.
 - 3) Thermal Resistance, R-value: At 1-1/2 inches thick; Class 1, Grades 1-2-3, 8.4 (1.48) at 75 degrees F.
 2. Board Size: 48 by 96 inches.
 3. Board Thickness: 4.0 inch maximum per layer.
 4. Tapered Board: Slope as indicated; minimum thickness 1/2 inch; fabricate of fewest layers possible.
 5. Board Edges: Square.

2.09 SURFACING MATERIALS - CONVENTIONAL APPLICATION

- A. Protective Coating: Acrylic, White color. Non-fibrated, semi-gloss, water-based acrylic roof coating.
 1. Surfacing:
 - a. Pyramic Plus LO: White elastomeric roof coating, Energy Star approved acrylic roof coating:
 - 1) Weight/Gallon 11.7 lbs./gal. (1.40 g/cm³).
 - 2) Non-Volatile % (ASTM D1644) 63 min.
 - 3) Reflectance 83%.

- b. Solex (Requires Pyramic or Pyramic Plus LO Base Coat): White elastomeric roof coating, Kynar based roof coating:
 - 1) Weight/Gallon 10.47 lbs./gal. (1.43 g/cm3).
 - 2) Non-Volatile % (ASTM D1644) 47.7 min.
 - 3) Reflectance 90%.
- B. Walkway Pads: Suitable for maintenance traffic, contrasting color or otherwise visually distinctive from roof membrane.
 - 1. Size: Manufacturer's standard size(s).
 - 2. Surface Color: White.
 - 3. If not indicated on on Drawings provide for 36 inch wide walking paths from the nearest point of normal roof access to all roof mounted HVAC and electrical equipment.
 - a. Walking path shall include all four sides of HVAC equipment and front access of electrical switches or panels.

2.10 EDGE TREATMENT AND ROOF PENETRATION FLASHINGS

- A. Vents and Breathers: Heavy gauge aluminum and fully insulated vent that allows moisture and air to escape but not enter the roof system as recommended and furnished by the membrane manufacturer.
- B. No Pitch pans, provide Rain Collars 24 gauge stainless or 20oz (567gram) copper. All joints should be welded/soldered watertight. See details for design.
- C. Drain Flashings should be 4lb (1.8kg) sheet lead formed and rolled.
- D. Plumbing stacks should be 4lb (1.8kg) sheet lead formed and rolled.
- E. Liquid Flashing - Tuff-Flash: An asphaltic-polyurethane, low odor, liquid flashing material designed for specialized details unable to be waterproofed with typical modified membrane flashings.
 - 1. Tensile Strength, ASTM D 412: 400 psi
 - 2. Elongation, ASTM D 412: 300%
 - 3. Density @77 deg. F 8.5 lb/gal typical
- F. Fabricated Flashings: Fabricated flashings and trim as specified using 22GA R-Mer Flat Sheet
 - 1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the CDA Copper Development Association "Copper in Architecture - Handbook" as applicable.
 - 2. See Section 07 62 00 - Sheet Metal Flashing and Trim.
- G. Manufactured Roof Specialties: Shop fabricated copings, fascia, gravel stops, control joints, expansion joints, joint covers and related flashings and trim.
 - 1. Manufactured roof specialties shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the NRCA "Roofing and Waterproofing Manual" as applicable.

2.11 ACCESSORIES

- A. Cant and Edge Strips: Inorganic fibrous glass, compatible with roofing materials ; cants formed to 45 degree angle.
- B. Insulation Joint Tape: Glass fiber reinforced type as recommended by insulation manufacturer, compatible with roofing materials; 6 inches wide; self adhering.

- C. Insulation Fasteners: Appropriate for purpose intended and approved by roofing manufacturer.
 - 1. Length as required for thickness of insulation material and penetration of deck substrate, with metal washers.
- D. Roofing Nails: Galvanized, hot-dipped type, size and configuration as required to suit application.
- E. Strip Reglet Devices: Galvanized steel, maximum possible lengths per location, with attachment flanges.
- F. Walkway Pad Adhesive: Adhesive used to adhere approved walk way pads as recommended and furnished by the membrane manufacturer
- G. Insulation Perimeter Restraint: Stainless steel edge device configured to restrain insulation boards in position and provide top flashing over ballast.
- H. Sealants: As recommended by membrane manufacturer.
- I. Rubber Blocks: 100% rubber blocks with steel channels and reflective strips designed for supporting conduit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces and site conditions are ready to receive work.
- B. Verify deck is supported and secure.
 - 1. Ensure that roof deck is structurally sound to support live and dead load requirements of roofing system and sufficiently rigid to support construction traffic.
 - 2. Distribute weight of packaged roofing materials over roof deck area to prevent substantial deflection of roof deck and overloading of the structure.
- C. Verify deck is clean and smooth, flat, free of depressions, waves, or projections, properly sloped and suitable for installation of roof system.
- D. Verify deck surfaces are dry and free of snow or ice.
 - 1. Do not conduct roofing operations when water in any form is present on deck, such as rain, dew or frost.
 - 2. Moisture Test: Conduct moisture test in accordance with roofing system manufacturer's instructions. Do not proceed with roofing application until deck is suitably dry.
- E. Verify that roof openings, curbs, and penetrations through roof are solidly set, and cant strips are in place.

3.02 PREPARATION - WOOD DECK

- A. Verify flatness and tightness of joints in wood decking; fill knot holes with latex filler.
- B. Seal joints of plywood with tape.
- C. Confirm dry deck by moisture meter with 12 percent moisture maximum.
- D. Conventional Application: Lay one ply of dry sheathing paper; lap edges 2 inches. Lay base sheet; lap edges 4 inches. Nail laps 6 inches on center. Nail field area at 12 inches on center, staggered.

3.03 INSTALLATION - GENERAL

- A. Install modified bitumen membranes and flashings in accordance with manufacturer's instructions and with the recommendations provided by the National Roofing Contractors Association's Roofing & Waterproofing Manual, the Asphalt Roofing Manufacturers Association, and applicable codes.
- B. General: Avoid installation of modified bitumen membranes at temperatures lower than 40-45 degrees F. When work at such temperatures unavoidable use the following precautions:
 - 1. Take extra care during cold weather installation and when ambient temperatures are affected by wind or humidity, to ensure adequate bonding is achieved between the surfaces to be joined. Use extra care at material seam welds and where adhesion of the applied product to the appropriately prepared substrate as the substrate can be affected by such temperature constraints as well.
 - 2. Unrolling of cold materials, under low ambient conditions must be avoided to prevent the likelihood of unnecessary stress cracking. Rolls must be at least 40 degrees F at the time of application. If the membrane roll becomes stiff or difficult to install, it must be replaced with roll from a heated storage area.
- C. Commence installation of the roofing system at the lowest point of the roof (or roof area), working up the slope toward the highest point. Lap sheets shingle fashion so as to constantly shed water
- D. All slopes greater than 2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral-shank 1 inch cap nails, or screws and plates at a rate of 1 fastener per ply (including the membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and 4 feet o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 2:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install 4 additional fasteners at the upper edge of the membrane when strapping the plies.

3.04 INSTALLATION - INSULATION, CONVENTIONAL

- A. Attachment of Insulation:
 - 1. Mechanically fasten first layer of insulation to deck in accordance with roofing manufacturer's instructions and Factory Mutual requirements (I-29).
 - 2. Embed second layer of insulation into adhesive in accordance with roofing and insulation manufacturers' instructions.
- B. Cover Boards: Mechanically fasten cover boards in accordance with roofing manufacturer's instructions.
- C. Lay subsequent layers of insulation with joints staggered minimum 6 inches from joints of preceding layer.
- D. Place tapered insulation to the required slope pattern in accordance with manufacturer's instructions.
- E. Lay boards with edges in moderate contact without forcing. Cut insulation to fit neatly to perimeter blocking and around penetrations through roof.
- F. Tape joints of insulation in accordance with roofing and insulation manufacturers' instructions.
- G. At roof drains, use factory-tapered boards to slope down to roof drains over a distance of 18 inches.
- H. Provide minimum 1/4:12 slope to drains, crickets and transitions.
- I. Do not apply more insulation than can be covered with membrane in same day.

3.05 FLASHING AND CANT APPLICATION

- A. See Section 07 62 00 - Sheet Metal Flashing and Trim.
- B. Details not addressed in Drawings and specification shall be in accordance with NRCA Manual Plates and recommendations, and the SMACNA (ASMM).
- C. Flashing and Sheet Metal Work: Set and flash in integrated sheet metal.
- D. Cants, Crickets, Saddles, and Tapered Areas: Install to fully support roofing membrane and to provide proper transitions at changes in roof plane.
 - 1. Install 45 degree cants where roof meets vertical surface, unless indicated otherwise.
 - 2. Install preformed crickets, saddles other tapered areas using insulation adhesive or a solid mopping of steep asphalt.
 - 3. Install tapered edge strips at roof edges where gravel stops, scuppers and sumps are installed.
- E. Fabricated Flashings: Fabricated flashings and trim are provided as specified
 - 1. Fabricated flashings and trim shall conform to the detail requirements of SMACNA "Architectural Sheet Metal Manual" and/or the Copper Development Association "Copper in Architecture - Handbook" as applicable.
- F. Liquid Flashing:
 - 1. Mask target area on roof membrane with tape.
 - 2. Clean all non-porous areas with isopropyl alcohol.
 - 3. Apply 32 wet mil base coat of liquid flashing over masked area.
 - 4. Embed polyester reinforcement fabric into the base coat of the liquid flashing.
 - 5. Apply 48-64 wet mil top coat of the liquid flashing material over the fabric extending 2 inches (51 mm) past the scrim in all directions.
 - 6. Apply minerals immediately or allow the liquid flashing material to cure 15-30 days and then install reflective coating.

3.06 INSTALLATION - MEMBRANE

- A. Install modified bituminous membrane roofing system in accordance with manufacturer's recommendations and NRCA (RM) applicable requirements.
 - 1. Comply with roofing system manufacturer's application instructions and recommendations for application of roofing system for specified applicator's extended warranty and manufacturer's guarantee.
- B. Comply with recommendations of NRCA ML104 and WSRCA recommendations and standard details, where more stringent than manufacturer's requirements and details indicated on Drawings.
 - 1. Provide pipe and conduit penetrations as indicated on Drawings, or if more stringent, as detailed in NRCA (RM).
- C. Install membrane; lap and seal edges and ends permanently waterproof.
- D. Install smooth, free from air pockets, wrinkles, fish-mouths, or tears. Ensure full bond of membrane to substrate.
- E. Install insulation and coverboard attached to the substrate with the appropriate fastener and fastening pattern determined from your wind uplift calculation.
- F. Base Ply: Prior to installation sweep or blow away any dust, dirt or sand particles, on the surface that could interfere with adhesion.

1. Prime the roof cover board at the recommended coverage rate with SA Primer at a rate of 0.50 gal per 100 sq.ft. Allow the primer to dry before installing the base sheet but it should be tacky for the base sheet application.
 2. Start HPR SA FR Base Sheet application at the low point of the roof with appropriate roll width to offset side laps 18 inches (457 mm) from side laps of base sheet. Install flush to roof edge if over base sheet, otherwise turn the HPR SA FR Base Sheet over the fascia minimum 2 inches (50 mm) and nail 9 inches (230 mm) o.c. At perimeter flashing extend the HPR SA FR Base Sheet up a minimum of 8 inches (203 mm). Design so that side laps are against the flow of water.
 3. Fold membrane back halfway lengthwise to remove the split release film. Press membrane securely into place, and repeat with the opposite half of the membrane. Use a heavy, weighted roller over entire surface of the HPR SA FR Base Sheet membrane to secure membrane. Work outwards to eliminate voids. When working with full rolls on large roofs, leave the membrane in position and remove the split release film from underneath the membrane.
 4. Overlap side laps of subsequent HPR SA FR Base Sheet membrane lengths 4 inches (100 mm) and end laps 8 inches (203 mm). Offset (stagger) end laps minimum 3 feet (0.9 m). Cut end laps at opposing diagonal corners at a 45 degree angle approximately 3 inches (76 mm) from the corners to minimize "T"- seams. Apply a bead or small trowel dab (quarter size) of Flashing Bond or Garla-Flex at the edge of the angled cut to avoid a capillary.
 5. Use of a hand-held hot air gun at joint area prior to rolling membrane to maximize adhesion. Apply a bead of Flashing Bond or Garla-Flex, at all HPR SA FR Base Sheet side and end laps to eliminate a capillary.
 6. Use a heavy, weighted roller over the entire surface of HPR SA FR Base Sheet to secure it in place and prevent voids, working outward from center of sheet.
 7. Repeat the above steps to properly build 1 to 2 plies, as specified, of HPR SA FR Base Sheet.
 8. Don't leave the installed HPR SA FR Base Sheet exposed to the weather; cover with StressPly SA FR Mineral cap sheet the same day.
- G. Modified Cap Ply(s): Prior to installation sweep or blow away any dust, dirt or sand particles, on the HPR SA FR Base Sheet that could interfere with adhesion.
1. Install StressPly SA FR Mineral starting at the low point of the roof with an appropriate roll width to offset sidelaps from the underlying membrane a minimum of 18 inches (457 mm). Work with manageable lengths for proper handling. Position with salvage edge release strip at high side of roof. Install in shingle fashion, with no laps against the flow of water.
 2. Once positioned, lift and fold back lengthwise the lower half of the membrane, remove the split release film, and press firmly into place. Repeat with the other (high side of the roof) half of the membrane. Follow the same layout and split release film procedures as for HPR SA FR Base Sheet, but overlap sidelaps 4 inches (100 mm) and endlaps 8 inches (203 mm).
 3. Use a heavy, weighted roller over the entire surface of the StressPly SA FR Mineral sheet to secure it in place and prevent voids, working outward from the center of the sheet.

4. As subsequent membrane lengths are installed, remove the selvage edge release strip just prior to overlapping to keep the adhesive area protected and clean. Cut endlaps at opposing diagonal corners at a 45 degree angle approximately 4 inches (100 mm) from the corners to minimize "T" seams. Use Flashing Bond or Garla-Flex trowel grade, over the full 8 inch (200 mm) width of each endlap prior to overlapping. Apply a uniform 1/8 to 1/4 inch (3 to 6 mm) troweling of the Flashing Bond or Garla-Flex the full width of the endlaps to the underlying membrane; then install the overlapping sheet.
 5. Always apply Flashing Bond or Garla-Flex the width of any overlap when applying the StressPly SA FR Mineral cap over another mineral surface such as the StressPly SA FR Mineral endlap.
 6. Install HPR SA FR Base Sheet and StressPly SA FR Mineral at vertical and other flashing over the already installed StressPly SA FR Mineral field plies.
- H. Fibrous Cant Strips: Provide non-combustible perlite or glass fiber cant strips at all wall/curb detail treatments where angle changes are greater than 45 degrees. Cant may be set in approved cold adhesives in accordance with Garland's recommendations.
- I. Wood Blocking, Nailers and Cant Strips: Provide wood blocking, nailers and cant strips as specified in Section 06 10 00 - Rough Carpentry and in accordance with Garland's recommendations.
- J. Metal Work: Provide metal flashings, counter flashings, parapet coping caps and thru-wall flashings as specified in Section 07 62 00 - Sheet Metal Flashing and Trim. Install in accordance with in accordance with Garland's recommendations.
- K. Termination Bar: Provide metal termination bar or approved top edge securement at the terminus of all flashing sheets at walls and curbs. Fasten the bar a minimum of 8 inches (203 mm) o/c to achieve constant compression. Provide suitable, sealant at the top edge if required.
- L. Flashing Base Ply: At all vertical and other flashing details, install HPR SA FR Base Sheet and StressPly SA FR Mineral over the already installed StressPly SA FR Mineral field plies.
1. Prime the horizontal surface with SA Primer at a rate of 0.5 gal per 100 sq.ft. and allowed to dry.
 2. Over installed StressPly SA FR Mineral field plies apply a 3 foot (0.9 m) wide HPR SA FR Base Sheet extending a minimum of 10 inches (254 mm) onto the field of the roof. Apply a uniform 1/8 to 1/4 inch (3 to 6 mm) thick troweling of Flashing Bond or Garla-Flex, on to the existing StressPly SA FR Mineral field cap.
 3. If adhesion is not sufficient on the laps apply Flashing Bond or Garla-Flex at a 1/8 to 1/4 inch (3-6 mm) thick to fully seal laps before application of StressPly SA FR Mineral.
 4. Before installing StressPly SA FR Mineral flashing ply to mineral surfaced field ply, apply Flashing Bond or Garla-Flex, wherever the membrane overlaps onto mineral surfacing. Proceed with StressPly SA FR Mineral cap sheet installation. Apply a 3 foot (0.9 m) wide StressPly SA FR mineral extending a minimum of 10 inches (254 mm) onto the field of the roof, being sure to cover the base ply.
 5. Once the membrane has had a chance to bond, check all laps and joints for full adhesion. If the membrane can be lifted at any area it is not properly adhered. Use a seam probing tool to check for small voids at laps. If necessary, use appropriate hand-held hot air welding tool and seam roller to seal small un-bonded areas.
- M. Surface Coatings: Apply roof coatings in strict conformance with the manufacturer's recommended procedures.
- N. Flashing Cap Ply: Apply as specified for Flashing Base Ply in strict conformance with the manufacturer's recommended procedures.

- O. At end of day's operation, install waterproof cut-off. Remove cut-off before resuming roofing.
- P. At intersections with vertical surfaces:
 - 1. Extend membrane over cant strips and up a minimum of 8 inches onto vertical surfaces.
 - 2. Apply flexible flashing over membrane.
 - 3. Secure flashing to nailing strips with termination bar and TF tape secured at 8 inches on center.
 - 4. Insert base flashing into reglets and secure.
- Q. Penetrations:
 - 1. Coordinate roofing Work with plumbing, mechanical and electrical Work and other Work involving penetrations of roofing membrane.
- R. At gravel stops, extend base sheet membrane under gravel stop and to the outside face of the wall.
- S. Around roof penetrations, mop in and seal flanges and flashings with flexible flashing.
- T. Coordinate installation of roof drains and sumps and related flashings.
- U. Other Roofing Accessories: Install other accessories in accordance with manufacturer's instructions and recommendations, and NRCA Construction Details, as applicable.

3.07 APPLICATION - SURFACE COVER, CONVENTIONAL

- A. Apply roof coatings in accordance with roofing and coating manufacturers' instructions.
- B. Install walkway pads by setting in roof cement. Set joints 6 inches apart. Avoid placement in waterways. If a waterway may be disturbed, cut pad in a diagonal manner to allow for the water way to be minimum 6 inches.
- C. Paint all exposed pipe stacks and mastic using non-fibrated white Title 24 coating after 30 day cure period.

3.08 WALKWAYS

- A. Traffic Pads Installation: Review layout with Architect before starting roofing application.
 - 1. If not indicated on on Drawings provide for 36 inch wide walking paths from the nearest point of normal roof access to all roof mounted HVAC and electrical equipment. Walking path shall include all four sides of HVAC equipment and front access of electrical switches or panels.
 - 2. Apply traffic pads in elastomeric adhesive in accordance with manufacturer's instructions and recommendations.

3.09 BUILDING IDENTIFICATION

- A. Provide the same roofing product specified to stencil building numbers and building description at each roof.
- B. Face the numbering/lettering toward the street. Locate as close to center of roof as possible.
- C. Numbers/Letters Character Shape: Block type.
 - 1. Character height: 72 inches, minimum.
 - 2. Stroke Width: 6 inches, minimum.
- D. Acrylic Paint Coating Thickness: Minimum 25 dry mils. Color: Black.

3.10 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

- B. The Testing Laboratory and Roofing Manufacturer's Representative will inspect deck surfaces before application of roofing materials and verify that substrate is in satisfactory condition to receive roofing, and furnish continuous inspection during application of roofing.
 - 1. The Testing Laboratory will inspect sheet metal flashings, counterflashings and reglets for satisfactory and waterproof installation.
- C. Require site attendance of roofing material manufacturers field inspection service periodically during installation of the Work.
 - 1. Provide manufacturer's field observations at start-up and at intervals of approximately 30 percent, 60 percent and 90 percent completion. Provide a final inspection upon completion of the Work.
 - a. Warranty shall be issued upon manufacturer's acceptance of the installation.
 - b. Field observations shall be performed by a Sales Representative employed full-time by the manufacturer and whose primary job description is to assist, inspect and approve membrane installations for the manufacturer.
 - c. Provide observation reports from the Sales Representative indicating procedures followed, weather conditions and any discrepancies found during inspection.
 - d. Provide a final report from the Sales Representative, certifying that the roofing system has been satisfactorily installed according to the project specifications, approved details and good general roofing practice.
 - 2. Regular daily written reports shall be provided to the Contractor and Architect for every day of roofing installation work.
 - 3. Roofing system manufacturer shall provide to Architect a written on-site approval and sign off on pre-roofing deck, base sheet installation, ply installation, MB cap sheet installation, flashing details and completed coating.
 - 4. Roofing system manufacturer shall provide to Architect a Project Closeout Report upon delivery of the project warranty. This report shall include the following sections:
 - a. Project Specifications
 - b. Project Summary
 - c. Progress reports as a result of roof inspections
 - d. Job progress photos
 - e. Warranty document with Maintenance Manual describing maintenance and emergency repair.
- D. Roofing Inspection and Testing Services by Independent Agency: District's independent agency will provide inspection and testing services during application of roofing system.
 - 1. Unless otherwise directed, inspection, including test cuts and evaluation procedures, will be performed in accordance with NRCA ML104.
 - 2. Independent agency will provide reports of inspections and tests to DSA and Architect. Copies of reports will also be provided to Contractor.
 - 3. Water Test: Conduct simulated rain storm test by indirect spray of water for 15 minutes over entire roof surface. Check area below roofing for leaks and check top surface for standing water.
 - a. Record test and inspection by video tape or digital recording.
 - 4. Remedial Work: Correct all defects and irregularities reported from inspections and tests, at no change in Contract Sum or Contract Time.

3.11 ADJUSTING

- A. Prior to Substantial Completion review, when remaining Work will not adversely affect or endanger roofing, Contractor and applicator shall make a final inspection of roofing and prepare a written report to District and Architect describing nature and extent of deterioration or damage, if any, found in the roofing Work.
- B. Repair or replace, as necessary, deteriorated or defective roofing and associated Work to a condition free of damage and deterioration, except normal weathering, at time of Substantial Completion review.

3.12 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove debris, scraps, containers and other rubbish and trash resulting from installation of the roofing system from job site each day.
- C. Remove bituminous markings from finished surfaces.
- D. In areas where finished surfaces are soiled by bitumen or other source of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and comply with their documented instructions.
- E. Repair or replace defaced or damaged finishes caused by work of this section.

3.13 PROTECTION

- A. Protect installed roofing and flashings from construction operations.
- B. Where traffic must continue over finished roof membrane, protect surfaces using durable materials.
- C. Storing, walking, wheeling or trucking is to be permitted directly on roofed surfaces only as recommended by the roofing system manufacturer. Provide protective coverings, including temporary plywood work surfaces, as necessary to protect completed roofing during subsequent construction activities.

3.14 FINAL INSPECTION

- A. At completion of roofing installation and associated work, meet with the Architect, installer, installer of associated work, District, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.
- B. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment.
 - 1. List all items requiring correction or completion and furnish copy of list to each party in attendance.
- C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor.
- D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.
- E. Repair or replace deteriorated or defective work found at time above inspection as required to a produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.
- F. Notify the Architect upon completion of corrections.

- G. Following the final inspection, provide written notice of acceptance of the installation from the roofing system manufacturer.
- H. Immediately correct roof leakage during construction. If the Contractor does not respond within twenty four (24) hours, the District will exercise rights to correct the Work under the terms of the Conditions of the Contract.

3.15 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
 - 1. Special Project Warranty: Provide specified warranty for the Project, executed by the authorized agent of the Manufacturer.
 - 2. Roofing Maintenance Instructions: Provide a manual of manufacturer's recommendations for maintenance of installed roofing systems.
 - 3. Insurance Certification: Assist District in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation of system to District's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Conduct walking tour of project.
 - 3. Briefly describe function, operation, and maintenance of each component.

END OF SECTION

SECTION 07 62 00 SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings, counterflashings, gutters, and downspouts.
- B. Sealants for joints within sheet metal fabrications.
- C. Sheet metal splash pans.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Flexible flashing.
- B. Division 7 - Thermal and Moisture Protection: Roofing system.
- C. Section 09 91 13 - Exterior Painting: Field painting.

1.03 REFERENCE STANDARDS

- A. AAMA 2605 - Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels (with Coil Coating Appendix); 2022.
- B. ASTM A527/A527M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Lock-Forming Quality; 1990 (Inactive).
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- D. ASTM B32 - Standard Specification for Solder Metal; 2020.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM D1970/D1970M - Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection; 2021.
- G. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- H. ASTM D3161/D3161M - Standard Test Method for Wind Resistance of Steep Slope Roofing Products (Fan-Induced Method); 2020.
- I. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension; 2016 (Reapproved 2021).
- J. ASTM D4586/D4586M - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007 (Reapproved 2018).
- K. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
- L. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement; 2020.
- M. SMACNA (ASMM) - Architectural Sheet Metal Manual; 2012.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
- C. Samples: Submit two samples 6 x 6 inch in size illustrating metal finish color.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA (ASMM) requirements and standard details, except as otherwise indicated.
- B. Maintain one copy of each document on site.
- C. Fabricator and Installer Qualifications: Company specializing in sheet metal work with five years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.01 SHEET MATERIALS

- A. Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal.
 - 1. Provide "Bonderized" finish (ASTM A527/A527M) where roofing membranes, or traffic coatings seal to sheet metal.
- B. Membrane Clad Flashing: Refer to Section 07 54 00 - Thermoplastic Membrane Roofing.
- C. Pre-Finished Galvanized Steel: ASTM A653/A653M, with G90/Z275 zinc coating; minimum 24-gauge, 0.0239-inch thick base metal, shop pre-coated with PVDF coating.
 - 1. Polyvinylidene Fluoride (PVDF) Coating: Superior performing organic powder coating, AAMA 2605; multiple coat, thermally cured fluoropolymer finish system.
 - 2. Color: As selected by Architect from manufacturer's custom colors.

2.02 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
 - 1. Coping and Cap Flashing:
 - a. Coping and caps of type and profile indicated on Drawings, 20 gage galvanized sheet metal, with integral expansion.
 - 2. Drips at Doors and Windows:
 - a. Provide 20 gage galvanized sheet metal drips at head of all exterior doors and windows where no roof or overhang protection occurs.
 - b. Extend drips 2 inches beyond jambs, unless noted otherwise.
- B. Perimeter metal blocking system:

1. Basis of Design Product: EdgeBox RI as manufactured by Hickman Edge Systems, or equal.
2. Two-piece assembly shall be fabricated from 20 Ga. galvanized steel with pre-punched fastener holes. The bottom section is attached to the metal deck with the provided mechanical fasteners. No slots are necessary for use with rigid insulation. Install per manufacturer's written instructions.
- C. Fabricate cleats of same material as sheet, minimum 4 inches wide, except at continuous strips, interlocking with sheet.
 1. Typically use continuous strips.
- D. Form pieces in longest possible lengths.
- E. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- F. Form material with flat lock seams, except where otherwise indicated; at moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
 1. Typical Seams: Overlapped and sealed seams.
 2. Coping Seams: Lock seams, flattened.
 3. Seams, Horizontal to Vertical Transitions: Solder joints.
 4. Soldered seams: Tin edges to be seamed, form seams, and solder.
- G. Fabricate corners from one piece with minimum 18-inch long legs; seam for rigidity, seal with sealant.
- H. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
- I. Fabricate flashings to allow toe to extend 2 inches over roofing gravel. Return and brake edges.

2.03 GUTTERS AND DOWNSPOUTS

- A. Gutters: SMACNA (ASMM) Rectangular profile.
- B. Downspouts: Profile as indicated.
 1. Steel Pipe Downspouts: See section 05 50 00 - Metal Fabrications.
 - a. Provide steel pipe downspouts where indicated. Fabricate from galvanized, Schedule 40 steel pipe or tube of sizes indicated. Weld joints and grind smooth. Shop prime with zinc-rich primer for field painting.
 - b. Provide necessary transitions from steel pipe to gage metal roof gutters and gutter outlets.
 - c. Hold downspouts in position 1 inch clear of walls with galvanized steel straps at spacing indicated, securely fastened to wall.
 - 1) Provide heavy duty mounting bracket hardware for attachment to structural steel.
- C. Scuppers and Overflows: 24 gage galvanized sheet metal, as indicated on Drawings and complying with referenced SMACNA Manual Figure number. Fabricate with minimum 6 inch flanges.
- D. Gutters and Downspouts: Size indicated.
- E. Accessories: Profiled to suit gutters and downspouts.
 1. Anchorage Devices: In accordance with SMACNA (ASMM) requirements.
 2. Gutter Supports: Straps.
 3. Downspout Supports: Straps.

- 4. Strainers 10 gage galvanized steel wire basket type, riveted and soldered into place.
- F. Splash Pans: Same metal type as downspouts, formed to 12 x 18 inches size; rolled sides of 1 inch high for inverted pan placement.
- G. Splash Pads: Precast concrete type, of size and profiles indicated; minimum 3,000 psi at 28 days, with minimum 5 percent air entrainment.
- H. Downspout Boots: Steel.
- I. Downspout Extenders: Same material and finish as downspouts.
- J. Seal metal joints.

2.04 EXTERIOR PENETRATION FLASHING PANELS

- A. Flashing Panels for Exterior Wall Penetrations: Premanufactured components and accessories as required to preserve integrity of building envelope; suitable for conduits and facade materials to be installed.
- B. Basis of Design Product: Quickflash Weatherproofing Flashing Panels as manufactured by Quickflash Weatherproofing Products, Inc., www.quickflashproducts.com, or equal.
- C. Coordinate with each trade to provide specific models correctly sized for each individual pipe, duct, conduit, box, or panel penetration in each application as occurs in the building envelope.
- D. Plumbing Flashing Panels:
 - 1. Materials:
 - a. Panel: Combination of high-density polyethylene (HDPE) and low-density polyethylene (LDPE).
 - 1) HDPE, Specific Gravity, ASTM D1505: 0.953 g/cm³.
 - 2) HDPE, Tensile Strength at Yield, ASTM D638: 3,100 psi.
 - 3) LDPE, Specific Gravity, ASTM D792: 0.917 g/cm³.
 - 4) LDPE, Tensile Strength at Yield, ASTM D638: 1,300 psi.
 - b. Weatherproof Seal: Thermoplastic elastomer.
 - 1) Hardness, ASTM D2240, Shore A, 10 Seconds: 46.
 - 2) Specific Gravity, ASTM D792: 1.05 g/cm³.
 - 3) Tensile Strength, ASTM D412: 490 psi.
- E. Electrical Flashing Panels:
 - 1. Material: Thermoplastic elastomer.
 - a. Hardness, ASTM D2240, Shore A, 10 Seconds: 93.
 - b. Specific Gravity, ASTM D792: 1.05 g/cm³.
 - c. Tensile Strength, ASTM D412: 1,300 psi.

2.05 ACCESSORIES

- A. Fasteners: Galvanized steel, with soft neoprene washers.
- B. Miscellaneous Metal Accessories: Provide sheet metal clips, straps, anchoring devices, and similar accessory units as required for installation of the Work, matching or compatible with material being installed, non-corrosive, size and gage required for performance.
- C. Underlayment: Self-adhesive sheet flexible flashing complying with ASTM D1970/D1970M.
 - 1. Adhesives: Type recommended by flexible flashing sheet manufacturer for waterproof/weather-resistant seaming and adhesive application of flashing sheet.

- D. Slip Sheet: Rosin-sized sheathing paper.
- E. Primer Type: Zinc chromate.
- F. Protective Backing Paint: Zinc molybdate alkyd.
- G. Concealed Sealants: Non-curing butyl sealant.
- H. Exposed Sealants: ASTM C920; elastomeric sealant, with minimum movement capability as recommended by manufacturer for substrates to be sealed; color to match adjacent material.
 - 1. 100 percent Silicone with minimum movement capability of plus/minus 25 percent and recommended by manufacturer for substrates to be sealed; clear.
 - 2. Epoxy Seam Sealer: 2-part non-corrosive metal seam cementing compound, recommended by metal manufacturer for exterior/interior non-moving joints including riveted joints.
- I. Asphalt Roof Cement: ASTM D4586/D4586M, Type I, asbestos-free.
- J. Reglets: Surface-mounted type, galvanized steel; face and ends covered with plastic tape.
 - 1. Reglets:
 - a. Surface-applied, Fry Springlok Flashing System Type SM, or equal.
 - b. Recessed, Fry Springlok Flashing System Type ST, or equal.
 - 2. Performance Requirements
 - a. Reglet and flashing manufacturer shall certify that the system to be installed has been tested to resist 110 MPH wind loads when tested in accordance with ASTM D3161/D3161M for a minimum period of two hours.
 - 3. Specified Manufacturer: Fry Reglet Corporation, www.fryreglet.com.
 - 4. Acceptable Manufacturers:
 - a. O'Keefes, Inc., www.okeefes.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 5. Reglets and Flashing, General: Springlok Flashing, as manufactured by Fry Reglet Corporation, or equal, formed metal reglet with snap-in metal counter-flashing, factory-fabricated, with a minimum opening of 1/4 inch and a depth of 1-1/4 inches.
 - a. Reglet material: 24 gage galvanized steel.
 - b. Flashing material: 0.020 inch Type 302 stainless steel.
 - c. End laps: Factory-formed, 1 inch at reglets and 3 inches at flashings.
 - d. Corners: Provide built-up mitered corner pieces for internal and external angles.
 - e. Wind clips: Provide Fry Windlok Clip, sheet metal clips to be secured to wall prior to installing flashing in reglet, and to be bent up over bottom edge of flashing.
 - 6. Accessories:
 - a. Corners: Factory-manufactured, mitered inside and outside corners.
 - b. Splices: Factory-manufactured, integral component of reglet and flashing system.
- K. Solder: ASTM B32, Alloy Grade - Sn50 (50/50).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.

- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.02 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Install surface mounted reglets true to lines and levels, and seal top of reglets with sealant.
- C. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil, 0.015 inch.

3.03 INSTALLATION

- A. Insert flashings into reglets to form tight fit; secure in place with lead wedges; pack remaining spaces with lead wool; seal flashings into reglets with sealant.
- B. Secure flashings in place using concealed fasteners, and use exposed fasteners only where permitted..
- C. Apply plastic cement compound between metal flashings and felt flashings.
- D. Fit flashings tight in place; make corners square, surfaces true and straight in planes, and lines accurate to profiles.
 - 1. Counterflashings Installation: Install counterflashing in reglets to form tight fit, either by snap-in seal arrangement or by securing in place with lead wedges spaced 18 inches on center maximum. Pack remaining spaces with lead wool.
 - a. Except where indicated or specified otherwise, insert counterflashing in reglets, extending down vertical surfaces over upturned vertical leg of base flashings not less than 3 inches.
 - b. Form counterflashings to required shapes before installation.
 - c. Lengths of metal counterflashings shall not exceed 120 inches.
 - d. Where stepped counterflashings are required, counterflashing may be installed in short lengths or may be of the preformed one-piece type.
 - e. Provide factory- or shop-form corners not less than 12 inches from the angle.
 - f. Provide end laps in counterflashings not less than 3 inches and make laps weathertight with sealant.
 - g. Turn up concealed edge of counterflashings built into masonry or concrete walls not less than 1/4 inch and extend not less than 2 inches into wall.
 - h. Fold exposed edges of counterflashings 1/2 inch.
 - i. Install counterflashing to provide a spring action against base flashing.
 - 2. Thru-Wall Flashing:
 - a. Start flashing 1/2 inch behind exposed face of wall and extend through wall.
 - b. Lap-seam joints and seal with sealant.
 - c. Provide sealant around penetrations through flashing.
- E. Seal metal joints watertight.
- F. Secure gutters and downspouts in place with concealed fasteners.
- G. Connect downspouts to downspout boots, and grout connection watertight.
- H. Set splash pans under downspouts. Set in place with adhesive .
- I. Scuppers and Overflows Installation:
 - 1. Mechanically fasten and solder joints.

2. Fold outside edges under 1/2 inch on all sides.
 3. Join the bottom edge to closure flange, where necessary, and form ridge to act as a gravel stop around scupper inlet.
 4. Coat interior of scuppers and overflows with bituminous plastic cement.
- J. Metal Flashing at Wall and Roof Penetrations and Equipment Supports:
1. Exception:
 - a. Roofing: Where single ply system assembly has provided flashing for penetrations.
 2. Penetrations through Single Ply (ex; PVC or TPO) membrane:
 - a. Roofing contractor is to install Single Ply (ex; PVC or TPO) cones and or flashing per roofing manufacturers standard details.
 - b. Roofing contractor is to provide sealant and stainless draw band to seal Single Ply (ex; PVC or TPO) cones and or flashings in accordance with the roofing manufacturer's standard details.
 3. Provide metal flashing for all pipes, ducts, and conduits projecting through the roof surface and for equipment supports, guy wire anchors, and similar items supported by or attached to the roof deck or walls.
 - a. Goose-necks, rainhoods, power roof ventilators, and other plumbing, HVAC and electrical products are specified as appropriate in:
 - 1) Division 21 - Fire Suppression.
 - 2) Division 22 - Plumbing.
 - 3) Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC).
 - 4) Division 26 - Electrical.
 - b. Coordinate also with sheet metal curbs specified in Section 07 72 00.
 4. Single Pipe Vents: Provide lead flashing as indicated on Drawings.
 - a. Set flange of sleeve in bituminous plastic cement and nail 3 inches on centers.
 - b. Bend the top of sleeve over and extend down into the vent pipe a minimum of 2 inches.
 - c. For long runs or long rises above the deck, where it is impractical to cover the vent pipe with lead, use a two-piece formed galvanized sheet metal housing.
 - d. Set metal housing with a metal sleeve having a 4 inch roof flange in bituminous plastic cement and nailed 3 inches on center.
 - e. Extend sleeve a minimum of 8 inches above the roof deck and lapped a minimum of 3 inches by a metal hood secured to the vent pipe by a draw band.
 - f. Seal the area of hood in contact with vent pipe with specified sealant. Sealants are specified in Section 07 92 00 - Joint Sealants.
 5. Roof Penetration Flashing:
 - a. Base Flashing:
 - 1) Extend flange onto roof 6 inches minimum away from penetration.
 - 2) Extend flange upward around penetration to at least 8 inches above roofing felts.
 - 3) Fold back upper and side roof flange edges 1/2 inch minimum.
 - 4) Lap and solder joints.
 - b. Counterflashing: Overlap base flashing 1 inch minimum with storm collar sloped away from penetration. Secure to penetration with draw band and sealant.

6. Equipment Support and Pad Flashing:
 - a. Fully cap support and pad.
 - b. Overlap base flashing 4 inches.
 - c. Lap and solder joints.
 - d. Provide sealant around penetrations through-flashing.

3.04 CLEANING AND PREPARATION FOR FIELD PAINTING

- A. Metal Preparation: As sheet metal installation progresses, neutralize excess flux with 5 to 10 percent washing soda solution, and thoroughly rinse.
- B. Repairs: Repair or replace damaged and deformed sheet metal.
- C. Cleaning: Wash down exposed surfaces and remove stains, scrap and debris such that sheet metal is ready to receive field painting and related Work.
 1. Wash down exposed surfaces and remove soiling, dust, contamination from steel wool and drilling residue, and other scrap and debris.
 2. Scrub surfaces with detergent solution as necessary to remove grease and oil films, handling marks, and stains.

3.05 FIELD PAINTING

- A. Field Painting: Field-paint exposed sheet metal for corrosion resistance and decorative purposes. Field finish painting is specified in Section 09 91 13 - Exterior Painting.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for field inspection requirements.
- B. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

3.07 SCHEDULE

- A. Fascia and Cornices: Prefinished.
- B. Gutters and Downspouts: Prefinished to match adjacent wall color.
- C. Scuppers: Thermoplastic membrane cladding, when adjacent to and a part of the roofing.
- D. Coping, Cap, Parapet, Sill and Ledge Flashings: Thermoplastic membrane cladding, when adjacent to and a part of the roofing.
- E. Flashings Associated with Roofing Tiles, including Valley, Hip, Ridge, Eave, Gutter Edge, Gable Edge, Chimney: Pre-finished
- F. Sheet Metal Roof Expansion Joint Covers, and Roof-to-Wall Joint Covers: Pre-finished to match adjacent wall color.
- G. Counterflashings at Roofing Terminations (over roofing base flashings): Thermoplastic membrane cladding.
- H. Counterflashings at Curb-Mounted Roof Items: Exposed galvanized, when behind a parapet; pre-finished otherwise
- I. Roofing Penetration Flashings, for Pipes, Structural Steel, and Equipment Supports: Exposed galvanized, when behind a parapet; pre-finished otherwise.

END OF SECTION

SECTION 07 72 00 ROOF ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Roof hatches.
- B. Non-penetrating pedestals.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications.
- B. Division 7 - Thermal and Moisture Protection: Roofing System
- C. Section 07 71 00 - Roof Specialties: Other manufactured roof specialty items.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.23 - Ladders; Current Edition.
- B. 29 CFR 1910.29 - Fall Protection Systems and Falling Object Protection - Criteria and Practices; Current Edition.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2018, with Amendment (2019).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used.
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
 - 4. Maintenance requirements.
- C. Shop Drawings: Submit detailed layout developed for this project and provide dimensioned location and number for each type of roof accessory.
 - 1. Non-penetrating Rooftop Supports: Submit design calculations for loadings and spacings.
 - 2. Submit shop drawings sealed and signed by a Professional Engineer experienced in design of this type of work and licensed in California.
- D. Warranty Documentation:
 - 1. Submit manufacturer warranty.

2. Ensure that forms have been completed in District's name and registered with manufacturer.
3. Submit documentation that roof accessories are acceptable to roofing manufacturer, and do not limit the roofing warranty.

1.05 QUALITY ASSURANCE

- A. Pre-Installation Conference: Participate in conference with insulation and built-up roofing manufacturer and applicator as required in roofing section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Store products in manufacturer's unopened packaging until ready for installation.
- C. Store products under cover and elevated above grade.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for hatches. Complete forms in District's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 5-year period commencing on Date of Substantial Completion.

1.08 WARRANTY

- A. Extended Warranty, Roof Hatches: Manufacturer's standard five year warranty.

PART 2 PRODUCTS

2.01 ROOF HATCHES

- A. Roof Hatch Manufacturers:
 1. Activar Construction Products Group - JL Industries: www.activarcpg.com/#sle.
 - a. Diamond Series model RHDG-7, without deflector plate.
 2. Acudor Products Inc: www.acudor.com/#sle.
 3. Babcock-Davis: www.babcockdavis.com/#sle.
 4. BILCO Company; Type E - Ladder Access: www.bilco.com/#sle.
 5. Dur-Red Products: www.dur-red.com.
 6. Precision Ladders, LLC; Model PH-A: www.precisionladders.com/#sle.
 7. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Roof Hatches: Factory-assembled aluminum frame and cover, complete with operating and release hardware.
 1. Basis of Design Product: PH-A2630-C PH-A 2'6" x 3'0" (762 mm x 914 mm) for an aluminum roof hatch. Roof Hatch with Folding Guard Rail System as manufactured by Precision Ladders LLC, or approved equal.
 2. Style: Provide flat metal covers unless otherwise indicated.
 3. Mounting: Provide frames and curbs suitable for mounting conditions as indicated on drawings.

4. Size: As indicated on drawings; single-leaf style unless otherwise indicated.
 - a. For Ladder Access: Single leaf; 30 by 36 inches.
- C. Frames and Curbs: One-piece curb and frame with integral cap flashing to receive roof flashings; extended bottom flange to suit mounting.
 1. Material: Mill finished aluminum, 11 gauge, 0.0907 inch thick.
 2. Insulation: Manufacturer's standard; 1 inch rigid glass fiber, located on outside face of curb.
 3. Curb Height: 12 inches from finished surface of roof, minimum.
 4. Flange: 3-1/2 inches with pre-drilled holes for attachment to roof deck..
- D. Metal Covers: Flush, insulated, hollow metal construction.
 1. Capable of supporting 40 psf live load, internal loading of 20 psf (0.96 kPa).
 2. Material: Mill finished aluminum; outer cover 11 gauge, 0.0907 inch thick, liner 0.04 inch thick.
 3. Insulation: Manufacturer's standard 1 inch rigid glass fiber.
 4. Gasket: Neoprene, continuous around cover perimeter.
- E. Safety Railing System: Roof hatch safety rail system mounted directly to curb without penetration of roofing system.
 1. Railing Size: 30 by 36 inches.
 2. Railing: Comply with 29 CFR 1910.23 for ladder safety, with a safety factor of two.
 - a. Folding Aluminum Guard Rail System shall support a load of 200 lbs applied in any direction.
 3. Self-Closing Gate: Comply with 29 CFR 1910.29 for safe egress and fall protection through hatch opening.
 4. Posts and Rails: Aluminum tube.
 5. Gate: Same material as railing; automatic closing with latch.
 6. Finish: Manufacturer's standard, factory applied finish.
 7. Gate Hinges and Post Guides: ASTM B221 (ASTM B221M), 6063 alloy, T5 temper aluminum.
 8. Mounting Brackets: Hot dipped galvanized steel, 1/4 inch thick, minimum.
 9. Fasteners: Stainless steel, Type 316.
 10. Products:
 - a. Basis of Design Product: Folding Guard Rail System as manufactured by Precision Ladders LLC, or approved equal.
 - b. Activar Construction Products Group, Inc. - JL Industries; RTA Safety Railing, Model RHG Series: www.activarcpg.com/#sle.
 - c. BILCO Company; Bil-Guard 2.0: www.bilco.com/#sle.
 - d. Safety Rail Company; Roof HatchGuard, Non-Penetrating Fall Protection: www.safetyrailcompany.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- F. Hardware: Steel, zinc coated and chromate sealed, unless otherwise indicated or required by manufacturer.

1. Lifting Mechanisms: Compression or torsion spring operator with shock absorbers that automatically opens upon release of latch; capable of lifting covers despite 10 psf load.
2. Hinges: Heavy duty pintle type.
3. Automatic hold open arm with vinyl-coated handle for manual release.
 - a. Automatic hold-open arm complete with red or contrasting colored vinyl grip handle to permit easy release and one-hand control of cover to closed and latched position.
4. Latch: Upon closing, engage latch automatically and reset manual release.
5. Manual Release: Pull handle on interior and exterior.
6. Locking: Padlock hasp on interior and exterior.

2.02 NON-PENETRATING ROOFTOP SUPPORTS/ASSEMBLIES

- A. Non-Penetrating Rooftop Support/Assemblies: Manufacturer-engineered and factory-fabricated, with pedestal bases that rest on top of roofing membrane, and not requiring any attachment to roof structure and not penetrating roofing assembly.
 1. Design Loadings and Configurations: As required by applicable codes.
 2. Height: Provide minimum clearance of 6 inches under supported items to top of roofing.
 3. Support Spacing and Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 4. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 5. Hardware, Bolts, Nuts, and Washers: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A153/A153M.
 6. Basis of Design Product: Dura-Blok Rooftop Supports as manufactured by Eaton, or equal.
 7. Products:
 - a. Eaton; Dura-Blok: www.eaton.com.
 - b. Metal Roof Innovations, Ltd. S-5! Attachment Solutions; S-5! Utility System: www.s-5.com/#sle.
 - c. PHP Systems/Design: www.phpsd.com/#sle.
 - d. Portals Plus: www.portalsplus.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Pipe Supports: Provide attachment fixtures complying with MSS SP-58 and as indicated.
 1. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports; corrosion resistant material.
 2. See relevant piping system specification section for additional requirements.
- C. Non-Penetrating Pedestals: Steel pedestals with square, round, or rectangular bases.
 1. Bases: High density polypropylene.
 2. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 3. Steel Components: Stainless steel, or carbon steel hot-dip galvanized after fabrication in accordance with ASTM A123/A123M.
 4. Products:

- a. Metal Roof Innovations, Ltd. S-5! Attachment Solutions; S-5! Utility System:
www.s-5.com/#sle.
- b. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

A. Ladder Safety Post:

1. Furnish and install where indicated on plans ladder safety post Model LU-1 manufactured by Bilco Company; www.bilco.com, or equal. The ladder safety post shall be pre-assembled from the manufacturer.
 - a. Substitutions: See Section 01 6000 - Product Requirements.
2. Performance characteristics:
 - a. Tubular post shall lock automatically when fully extended.
 - b. Safety post shall have controlled upward and downward movement.
 - 1) Release lever shall disengage the post to allow it to be returned to its lowered position.
 - c. Adjustable Mounting Bracket Spacing: Up to 14 inches on center.
 - 1) Clamp Bracket Size: 1-1/4 inch in diameter.
3. Post: High strength square tubing. A pull up loop shall be provided at the upper end of the post to facilitate raising the post.
4. Activation: Pull up loop shall be provided at the upper end of the post to facilitate raising the post.
5. Material of construction: Steel (Model LU-1, LU-2).
6. Balancing spring: A stainless steel spring balancing mechanism shall be provided to provide smooth, easy, controlled operation when raising and lowering the safety post.
7. Hardware: All mounting hardware shall be Type 316 stainless steel.
8. Factory Finish: Yellow powder coat steel (Model LU-1).

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using methods recommended by manufacturer for achieving acceptable results for applicable substrate under project conditions.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions, in manner that maintains roofing system weather-tight integrity.
- B. Operational Units: Test and operate units with operable components. Clean and lubricate joints and hardware. Adjust for proper operation.

3.04 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Clean installed work to like-new condition.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 07 92 00 JOINT SEALANTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Self-leveling pourable joint sealants.
- C. Joint backings and accessories.
- D. District-provided field quality control.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions: Additional requirements for sealants and primers.
- B. Section 09 30 00 - Tiling: Sealant between tile and plumbing fixtures and at junctions with other materials and changes in plane.

1.03 REFERENCE STANDARDS

- A. ASTM C661 - Standard Test Method for Indentation Hardness of Elastomeric-Type Sealants by Means of a Durometer; 2015 (Reapproved 2022).
- B. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2018 (Reapproved 2022).
- C. ASTM C834 - Standard Specification for Latex Sealants; 2017 (Reapproved 2023).
- D. ASTM C919 - Standard Practice for Use of Sealants in Acoustical Applications; 2022.
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems; 2023.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- H. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants; 2022.
- I. ASTM C1311 - Standard Specification for Solvent Release Sealants; 2022.
- J. ASTM C1521 - Standard Practice for Evaluating Adhesion of Installed Weatherproofing Sealant Joints; 2019 (Reapproved 2020).
- K. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2015 (Reapproved 2021).
- L. SCAQMD 1168 - Adhesive and Sealant Applications; 1989, with Amendment (2022).
- M. SWRI (VAL) - SWR Institute Validated Products Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Submit manufacturer's technical datasheets for each product to be used; include the following:
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.

2. List of backing materials approved for use with the specific product.
 3. Backing material recommended by sealant manufacturer.
 4. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 5. Substrates the product should not be used on.
 6. Substrates for which use of primer is required.
 7. Substrates for which laboratory adhesion and/or compatibility testing is required.
 8. Installation instructions, including precautions, limitations, and recommended backing materials and tools.
 9. Sample product warranty.
 10. Certification by manufacturer indicating that product complies with specification requirements.
 11. SWRI Validation: Provide currently available sealant product validations as listed by SWRI (VAL) for specified sealants.
- C. Product Data for Accessory Products: Submit manufacturer's technical data sheet for each product to be used, including physical characteristics, installation instructions, and recommended tools.
- D. Color Cards for Selection: Where sealant color is not specified, submit manufacturer's color cards showing standard colors available for selection.
- E. Samples for Verification: Where custom sealant color is specified, obtain directions from Architect and submit at least two physical samples for verification of color of each required sealant.
- F. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.
- G. Installation Plan: Submit at least four weeks prior to start of installation.
- H. Preinstallation Field Adhesion Test Plan: Submit at least two weeks prior to start of installation.
- I. Field Quality Control Plan: Submit at least two weeks prior to start of installation.
- J. Preinstallation Field Adhesion Test Reports: Submit filled out Preinstallation Field Adhesion Test Reports log within 10 days after completion of tests; include bagged test samples and photographic records.
- K. Installation Log: Submit filled-out log for each length or instance of sealant installed.
- L. Field Quality Control Log: Submit filled-out log for each length or instance of sealant installed, within 10 days after completion of inspections/tests; include bagged test samples and photographic records, if any.
- M. Manufacturer's qualification statement.
- N. Installer's qualification statement.
- O. Executed warranty.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document covering installation requirements on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Installer Qualifications: Company specializing in performing the work of this section and with at least three years of documented experience.
- D. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
 - 1. Adhesion Testing: In accordance with ASTM C794.
 - 2. Compatibility Testing: In accordance with ASTM C1087.
 - 3. Allow sufficient time for testing to avoid delaying the work.
 - 4. Deliver sufficient samples to manufacturer for testing.
 - 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 - 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.
- E. Installation Plan: Include schedule of sealed joints, including the following:
 - 1. Joint width indicated in Contract Documents.
 - 2. Joint depth indicated in Contract Documents; to face of backing material at centerline of joint.
 - 3. Method to be used to protect adjacent surfaces from sealant droppings and smears, with acknowledgment that some surfaces cannot be cleaned to like-new condition and therefore prevention is imperative.
 - 4. Approximate date of installation, for evaluation of thermal movement influence.
 - 5. Installation Log Form: Include the following data fields, with known information filled out.
 - a. Unique identification of each length or instance of sealant installed.
 - b. Location on project.
 - c. Substrates.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Primer to be used, or indicate no primer is used.
 - g. Size and actual backing material used.
 - h. Date of installation.
 - i. Name of installer.
 - j. Actual joint width; provide space to indicate maximum and minimum width.
 - k. Actual joint depth to face of backing material at centerline of joint.
 - l. Air temperature.
- F. Preinstallation Field Adhesion Test Plan: Include destructive field adhesion testing of one sample of each combination of sealant type and substrate, except interior acrylic latex sealants, and include the following for each tested sample.
 - 1. Identification of testing agency.
 - 2. Name(s) of sealant manufacturer's field representatives who will be observing.
 - 3. Preinstallation Field Adhesion Test Log Form: Include the following data fields, with known information filled out.

- a. Substrate; if more than one type of substrate is involved in a single joint, provide two entries on form, for testing each sealant substrate side separately.
 - b. Test date.
 - c. Location on project.
 - d. Sealant used.
 - e. Stated movement capability of sealant.
 - f. Test method used.
 - g. Date of installation of field sample to be tested.
 - h. Date of test.
 - i. Copy of test method documents.
 - j. Age of sealant upon date of testing.
 - k. Test results, modeled after the sample form in the test method document.
 - l. Indicate use of photographic record of test.
- G. District will employ an independent testing agency to perform the field quality control inspection and testing as referenced in PART 3 of this section and as follows, to prepare and submit the field quality control plan and log, and to provide recommendations of remedies in the case of failure.
 1. Contractor shall cooperate with testing agency and repair failures discovered and destructive test location damage.
- H. Field Quality Control Plan:
 1. Visual inspection of entire length of sealant joints.
 2. Nondestructive field adhesion testing of sealant joints, except interior acrylic latex sealants.
 - a. For each different sealant and substrate combination, allow for one test every 12 inches in the first 10 linear feet of joint and one test every 24 inches thereafter.
 - b. If any failures occur in the first 10 linear feet, continue testing at 12 inches intervals at no extra cost to District.
 3. Destructive field adhesion testing of sealant joints, except interior sealant joints.
 - a. For each different sealant and substrate combination, allow for one test every 100 feet in the first 1,000 linear feet, and one test per 1,000 linear feet thereafter, or once per floor on each elevation.
 - b. If any failures occur in the first 1,000 linear feet, continue testing at frequency of one test per 500 linear feet at no extra cost to District.
 4. Field Quality Control Log Form: Show same data fields as on Preinstallation Field Adhesion Test Log, with known information filled out and lines for multiple tests per sealant/substrate combinations; include visual inspection and specified field testing; allow for possibility that more tests than minimum specified may be necessary.
- I. Field Adhesion Test Procedures:
 1. Allow sealants to fully cure as recommended by manufacturer before testing.
 2. Have a copy of the test method document available during tests.
 3. Take photographs or make video records of each test, with joint identification provided in the photos/videos; for example, provide small erasable whiteboard positioned next to joint.

4. Record the type of failure that occurred, other information required by test method, and the information required on the Field Quality Control Log.
 5. When performing destructive tests, also inspect the opened joint for proper installation characteristics recommended by manufacturer, and report any deficiencies.
 6. Deliver the samples removed during destructive tests in separate sealed plastic bags, identified with project, location, test date, and test results, to District.
 7. If any combination of sealant type and substrate does not show evidence of minimum adhesion or shows cohesion failure before minimum adhesion, report results to Architect.
- J. Nondestructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Nondestructive Spot Method.
1. Record results on Field Quality Control Log.
 2. Repair failed portions of joints.
- K. Destructive Field Adhesion Test: Test for adhesion in accordance with ASTM C1521, using Destructive Tail Procedure.
1. Sample: At least 18 inches long.
 2. Minimum Elongation Without Adhesive Failure: Consider the tail at rest, not under any elongation stress; multiply the stated movement capability of the sealant in percent by two; then multiply 1 inch by that percentage; if adhesion failure occurs before the 1-inch mark is that distance from the substrate, the test has failed.
 3. If either adhesive or cohesive failure occurs before minimum elongation, take necessary measures to correct conditions and retest; record each modification to products or installation procedures.
 4. Record results on Field Quality Control Log.
 5. Repair failed portions of joints.
- L. Field Adhesion Tests of Joints: Test for adhesion using most appropriate method in accordance with ASTM C1521, or another applicable method as recommended by manufacturer.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 2-year manufacturer warranty for installed sealants and accessories that fail to achieve a watertight seal, exhibit loss of adhesion or cohesion, or do not cure. Complete forms in District's name and register with manufacturer.
- C. Extended Correction Period: Correct defective work within 2-year period commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Nonsag Sealants:
 1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
 2. Bostik Inc: www.bostik-us.com/#sle.
 3. Dow: www.dow.com/#sle.
 4. Franklin International, Inc: www.titebond.com/#sle.
 5. Henry Company: www.henry.com/#sle.

6. Hilti, Inc: www.hilti.com/#sle.
7. Master Builders Solutions: www.master-builders-solutions.com/en-us/#sle.
8. Momentive Performance Materials, Inc (formerly GE Silicones):
www.momentive.com/#sle.
9. Pecora Corporation: www.pecora.com/#sle.
10. QUIKRETE Companies: www.quikrete.com/#sle.
11. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
12. Sika Corporation: www.usa.sika.com/#sle.
13. Specified Technologies Inc: www.stifirestop.com/#sle.
14. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
15. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
16. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

B. Self-Leveling Sealants:

1. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
2. Bostik Inc: www.bostik-us.com/#sle.
3. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
4. Dow: www.dow.com/#sle.
5. Master Builders Solutions: www.master-builders-solutions.com/en-us/#sle.
6. Pecora Corporation: www.pecora.com/#sle.
7. QUIKRETE Companies: www.quikrete.com/#sle.
8. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
9. Sika Corporation: www.usa.sika.com/#sle.
10. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
11. W.R. Meadows, Inc: www.wrmeadows.com/#sle.
12. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.02 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints:
 - a. Do not seal exterior joints unless indicated on drawings as sealed.
 - b. Seal open joints except open joints indicated on drawings as not sealed.
2. Interior Joints:
 - a. Do not seal interior joints indicated on drawings as not sealed.
 - b. Do not seal gaps and openings in gypsum board and suspended ceilings
 - c. Do not seal through-penetrations in sound-rated assemblies that are also fire-rated assemblies.
 - d. Seal the following joints:
 - 1) Joints between door frames and window frames and adjacent construction.
 - 2) In sound-rated wall and ceiling assemblies, gaps at electrical outlets, wiring devices, and piping penetrations.

- 3) In sound-rated wall and ceiling assemblies, seal joints between wall assemblies and ceiling assemblies; between wall assemblies and other construction; between ceiling assemblies and other construction.
3. Do Not Seal:
 - a. Intentional weep holes in masonry.
 - b. Joints indicated to be covered with expansion joint cover assemblies.
 - c. Joints where sealant is specified to be furnished and installed by manufacturer of product to be sealed.
 - d. Joints where sealant installation is specified in other sections.
 - e. Joints between suspended ceilings and walls.
- B. Exterior Joints: Use nonsag nonstaining silicone sealant, unless otherwise indicated.
 1. Type SM-1 - Lap Joints in Sheet Metal Fabrications: Butyl rubber, noncuring.
 2. Type SM-1 - Lap Joints between Manufactured Metal Panels: Butyl rubber, noncuring.
 3. Type CP-1 - Control and Expansion Joints in Concrete Paving: Self-leveling polyurethane traffic-grade sealant.
 4. Type IA-1 - Wall and Ceiling Joints in Nonwet Areas: Acrylic emulsion latex sealant.
 5. Type WP-1 - Wall and Ceiling Joints in Wet Areas: Nonsag polyurethane sealant for continuous liquid immersion.
 6. Type WP-1 - Floor Joints in Wet Areas: Nonsag polyurethane non-traffic-grade sealant suitable for continuous liquid immersion.
 7. Type FS-1 - Joints between Tile in Wet Areas and Floors, Walls, and Ceilings: Mildew-resistant silicone sealant; white.
 - a. See Section 09 30 00 for sealing between tile and plumbing fixtures.
- C. Interior Wet Areas: Bathrooms, restrooms, kitchens, food service areas, and food processing areas; fixtures in wet areas include plumbing fixtures, food service equipment, countertops, cabinets, and other similar items.

2.03 JOINT SEALANTS - GENERAL

- A. Sealants and Primers: Provide products having lower volatile organic compound (VOC) content than indicated in SCAQMD 1168.
- B. Colors: As indicated on drawings.

2.04 NONSAG JOINT SEALANTS

- A. Type NS-1 - Nonstaining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Nonstaining to Porous Stone: Nonstaining to light-colored natural stone when tested in accordance with ASTM C1248.
 3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
 4. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 5. Color: Match adjacent finished surfaces.
 6. Service Temperature Range: Minus 20 to 180 degrees F.
 7. Products:
 - a. Dow; DOWSIL 756 SMS Building Sealant: www.dow.com/#sle.

- b. Dow; DOWSIL 790 Silicone Building Sealant: www.dow.com/#sle.
 - c. Dow; DOWSIL 791 Silicone Weatherproofing Sealant: www.dow.com/#sle.
 - d. Dow; DOWSIL 795 Silicone Building Sealant: www.dow.com/#sle.
 - e. Momentive Performance Materials, Inc/GE Silicones; SCS9000 SilPruf NB - Non-Staining Silicone Weatherproofing Sealant: www.siliconeforbuilding.com/#sle.
 - f. Pecora Corporation; Pecora 890 NST (Non-Staining Technology): www.pecora.com/#sle.
 - g. Pecora Corporation; Pecora 864 NST (Non-Staining Technology): www.pecora.com/#sle.
 - h. Sika Corporation; Sikasil WS-290: www.usa.sika.com/#sle.
 - i. Sika Corporation; Sikasil WS-295: www.usa.sika.com/#sle.
 - j. Sika Corporation; Sikasil 728NS: www.usa.sika.com/#sle.
 - k. Tremco Commercial Sealants & Waterproofing; Spectrem 1: www.tremcosealants.com/#sle.
 - l. Tremco Commercial Sealants & Waterproofing; Spectrem 2: www.tremcosealants.com/#sle.
 - m. Tremco Commercial Sealants & Waterproofing; Spectrem 3: www.tremcosealants.com/#sle.
 - n. Tremco Commercial Sealants & Waterproofing; Spectrem 4-TS: www.tremcosealants.com/#sle.
 - o. Tremco Commercial Sealants & Waterproofing; Tremsil 200: www.tremcosealants.com/#sle.
 - p. Tremco Commercial Sealants & Waterproofing; Tremsil 400: www.tremcosealants.com/#sle.
 - q. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 25 percent, minimum.
 - 2. Hardness Range: 15 to 35, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.
 - 4. Cure Type: Single component, neutral moisture curing.
 - 5. Service Temperature Range: Minus 65 to 180 degrees F.
 - 6. Products:
 - a. Dow; DOWSIL 999-A Building and Glazing Sealant: www.dow.com/#sle.
 - b. Dow; DOWSIL 758 Silicone Weather Barrier Sealant: www.dow.com/#sle.
 - c. Henry Company; Moistop Sealant: www.henry.com/#sle.
 - d. Momentive Performance Materials, Inc/GE Silicones; SCS2000 SilPruf - Silicone Sealant and Adhesive: www.siliconeforbuilding.com/#sle.
 - e. Momentive Performance Materials, Inc/GE Silicones; SCS2700 SilPruf LM (Low Modulus) - Silicone Weatherproofing Sealant: www.siliconeforbuilding.com/#sle.
 - f. Momentive Performance Materials, Inc/GE Silicones; SSG4600 UltraGlaze - Silicone Structural Glazing Adhesive: www.siliconeforbuilding.com/#sle.
 - g. Pecora Corporation; Pecora 860: www.pecora.com/#sle.

- h. Pecora Corporation; Pecora 890FTS (Field Tintable Smooth): www.pecora.com/#sle.
 - i. Pecora Corporation; Pecora 890FTS-TXTR (Field Tintable Textured): www.pecora.com/#sle.
 - j. Sherwin-Williams Company; Silicone Rubber All Purpose Sealant: www.sherwin-williams.com/#sle.
 - k. Sika Corporation; Sikasil GP: www.usa.sika.com/#sle.
 - l. Sika Corporation; Sikasil WS-295: www.usa.sika.com/#sle.
 - m. Sika Corporation; Sikasil N-Plus US: www.usa.sika.com/#sle.
 - n. Sika Corporation; Sikasil 728NS: www.usa.sika.com/#sle.
 - o. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Type FS-1 - Mildew-Resistant Silicone Sealant: ASTM C920, Grade NS, Uses M and A; single component, mildew resistant; not expected to withstand continuous water immersion or traffic.
- 1. Color: White.
 - 2. Products:
 - a. BASF Construction Chemicals-Building Systems; OmniPlus, by Sonneborn Building Products Div.: www.buildingsystems.basf.com.
 - b. Dow Corning Corporation; 786 Silicone Sealant: www.dowcorning.com.
 - c. Momentive Performance Materials, Inc (GE Silicones products); Silpruf SCS 1700 Sanitary: www.momentive.com.
 - d. Pecora Corporation; Pecora 898 NST (Non-Staining Technology): www.pecora.com/#sle.
 - e. Sika Corporation; Sikasil GP: www.usa.sika.com/#sle.
 - f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Type ST-1 - Hybrid Elastomeric Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
- 1. Movement Capability: Plus and minus 50 percent, minimum.
 - 2. Hardness Range: 15 to 25, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's full range.
 - 4. Service Temperature Range: Minus 75 to 300 degrees F.
 - 5. Products:
 - a. Dow; DOWSIL Contractors Paintable Sealant - CPS: www.dow.com/#sle.
 - b. Franklin International Inc; Titebond WeatherMaster Sealant: www.titebond.com/#sle.
 - c. Master Builders Solutions; MasterSeal NP100: www.master-builders-solutions.com/en-us/#sle.
 - d. Sherwin-Williams Company; Stampede 100 Low-Modulus Hybrid Urethane Sealant: www.sherwin-williams.com/#sle.
 - e. Sherwin-Williams Company; Stampede 1H Hybrid Sealant: www.sherwin-williams.com/#sle.
 - f. Tremco Commercial Sealants and Waterproofing; Dymonic FC: www.tremcosealants.com/#sle.
 - g. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

6. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
7. Color: To be selected by Architect from manufacturer's full range.
8. Service Temperature Range: Minus 40 to 180 degrees F.
9. Products:
 - a. Master Builders Solutions; MasterSeal NP1: www.master-builders-solutions.com/en-us/#sle.
 - b. Pecora Corporation; DynaTrol II: www.pecora.com/#sle.
 - c. Pecora Corporation; DynaFlex: www.pecora.com/#sle.
 - d. Sherwin-Williams Company; Stampede-1/-TX Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - e. Sika Corporation; Sikaflex-1a: www.usa.sika.com/#sle.
 - f. Sika Corporation; Sikaflex-15 LM: www.usa.sika.com/#sle.
 - g. Tremco Commercial Sealants & Waterproofing; Dymonic 100: www.tremcosealants.com/#sle.
 - h. Tremco Commercial Sealants & Waterproofing; Vulkem 116: www.tremcosealants.com/#sle.
 - i. W. R. Meadows, Inc; POURTHANE NS: www.wrmeadows.com/#sle.
 - j. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Type WP-1 - Polyurethane Sealant for Continuous Water Immersion: ASTM C920, Grade NS, Uses M and A; single or multicomponent; explicitly approved by manufacturer for continuous water immersion; suitable for traffic exposure when recessed below traffic surface.
 1. Movement Capability: Plus and minus 35 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Products:
 - a. Sika Corporation; Sikaflex-1a: www.usa.sika.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- F. Nonsag Traffic-Grade Polyurethane Sealant: ASTM C920, Grade NS, Uses M and A; single or multi-component; explicitly approved by manufacturer for continuous water immersion and traffic without the necessity to recess sealant below traffic surface.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 20 to 30, Shore A, when tested in accordance with ASTM C661.
 3. Color: Match adjacent finished surfaces.
- G. Polysulfide Sealant: ASTM C920, Grade NS, Uses M and A; single component; not expected to withstand continuous water immersion or traffic.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 20 to 35, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Products:
 - a. Pecora Corporation: www.pecora.com/#sle.

- b. W.R. Meadows, Inc; Deck-O-Seal Gun Grade: www.wrmeadows.com/#sle.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- H. Type IA-1 - Acrylic Emulsion Latex: Water-based; ASTM C834, single component, nonstaining, nonbleeding, nonsagging; not intended for exterior use.
- 1. Color: To be selected by Architect from manufacturer's full range.
 - 2. Grade: ASTM C834; Grade 0 Degrees F (Minus 18 Degrees C).
 - 3. Products:
 - a. Franklin International, Inc; Titebond Pro-Grade Plus Caulk: www.titebond.com/#sle.
 - b. Hilti, Inc; CP 506 Smoke and Acoustical Sealant: www.us.hilti.com/#sle.
 - c. Hilti, Inc; CP 572 Smoke and Acoustical Spray Sealant: www.us.hilti.com/#sle.
 - d. Hilti, Inc; Lightweight Smoke and Acoustic Sealant CS-S SA Light: www.us.hilti.com/#sle.
 - e. OSI Greenseries SC-175 Draft & Acoustical Sound Sealant; www.ositough.com.
 - f. Pecora Corporation; AC-20 +Silicone: www.pecora.com/#sle.
 - g. Sherwin-Williams Company; White Lightning 3006 Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - h. Sherwin-Williams Company; 850A Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - i. Sherwin-Williams Company; 950A Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - j. Sherwin-Williams Company; Bolt Quickdry Siliconized Acrylic Latex Caulk: www.sherwin-williams.com/#sle.
 - k. Sherwin-Williams Company; Powerhouse Siliconized Acrylic Latex Sealant: www.sherwin-williams.com/#sle.
 - l. Specified Technologies Inc; Smoke N' Sound Acoustical Sealant: www.stifirestop.com/#sle.
 - m. Top Gun, a brand of PPG Architectural Coatings; Top Gun 200: www.ppgpaints.com/#sle.
 - n. Tremco Commercial Sealants & Waterproofing; Tremflex 834: www.tremcosealants.com/#sle.
 - o. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound: www.tremcosealants.com/#sle.
 - p. Tremco Commercial Sealants & Waterproofing; Tremstop Smoke and Sound Spray: www.tremcosealants.com/#sle.
 - q. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.05 SELF-LEVELING JOINT SEALANTS

- A. Self-Leveling Silicone Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent, explicitly approved by manufacturer for traffic exposure when recessed below traffic surface; not expected to withstand continuous water immersion.
- 1. Movement Capability: Plus 100 percent, minus 50 percent, minimum.
 - 2. Hardness Range: 0 to 15, Shore A, when tested in accordance with ASTM C661.
 - 3. Color: To be selected by Architect from manufacturer's standard range.

4. Service Temperature Range: Minus 40 to 180 degrees F.
5. Products:
 - a. Dow; DOWSIL SL Parking Structure Sealant: www.dow.com/#sle.
 - b. Pecora Corporation; Pecora 300 SL (Self-Leveling): www.pecora.com/#sle.
 - c. Pecora Corporation; Pecora 322 FC (Fast Cure): www.pecora.com/#sle.
 - d. Sika Corporation; Sikasil 728SL: www.usa.sika.com/#sle.
 - e. Tremco Commercial Sealants & Waterproofing; Spectrem 900SL: www.tremcosealants.com/#sle.
 - f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Type P-1 - Self-Leveling Polyurethane Sealant: ASTM C920, Grade P, Uses M and A; single or multicomponent; explicitly approved by manufacturer for traffic exposure; not expected to withstand continuous water immersion .
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Products:
 - a. Pecora Corporation: www.pecora.com/#sle.
 - b. Sherwin-Williams Company; Stampede 1SL Polyurethane Sealant: www.sherwin-williams.com/#sle.
 - c. Sika Corporation; Sikaflex-1c SL: www.usa.sika.com/#sle.
- C. Type WFP-1 - Self-Leveling Polyurethane Sealant for Continuous Water Immersion: Polyurethane; ASTM C920, Grade P, Uses M and A; single component; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent, minimum.
 2. Hardness Range: 35 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Products:
 - a. Sika Corporation; Sikaflex-1c SL: www.usa.sika.com/#sle.
 - b. W. R. MEADOWS, Inc; POURTHANE SL: www.wrmeadows.com/#sle.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Self-Leveling Polysulfide Sealant: ASTM C920, Grade P, Uses M and A; multicomponent; explicitly approved by manufacturer for traffic exposure and continuous water immersion.
 1. Movement Capability: Plus and minus 25 percent.
 2. Hardness Range: 30 to 55, Shore A, when tested in accordance with ASTM C661.
 3. Color: To be selected by Architect from manufacturer's standard range.
 4. Service Temperature Range: Minus 40 to 180 degrees F.
 5. Products:
 - a. W.R. Meadows, Inc; Deck-O-Seal (pourable): www.wrmeadows.com/#sle.
 - b. W.R. Meadows, Inc; Deck-O-Seal 125: www.wrmeadows.com/#sle.

- c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Rigid Self-Leveling Polyurethane Joint Filler: Two part, low viscosity, fast setting; intended for cracks and control joints not subject to significant movement.
 - 1. Hardness Range: Greater than 100, Shore A, and 50 to 80, Shore D, when tested in accordance with ASTM C661.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX ARDIFIX: www.ardexamericas.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- F. Type EPX-1 - Semi-Rigid Self-Leveling Epoxy Joint Filler: Epoxy or epoxy/polyurethane copolymer; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Multicomponent, 100 percent solids by weight.
 - 2. Durometer Hardness: Minimum of 85 for Type A or 35 for Type D, after seven days when tested in accordance with ASTM D2240.
 - 3. Color: Concrete gray.
 - 4. Joint Width, Minimum: 1/8 inch.
 - 5. Joint Width, Maximum: 1/4 inch.
 - 6. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.
 - 7. Products:
 - a. Dayton Superior Corporation: www.daytonsuperior.com/#sle.
 - b. Euclid Chemical Company; EUCO 700: www.euclidchemical.com/#sle.
 - c. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com/#sle.
 - d. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- G. Semi-Rigid Self-Leveling Polyurea Joint Filler: Two-component, 100 percent solids; intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Durometer Hardness, Type A: 75, minimum, after seven days when tested in accordance with ASTM D2240.
 - 2. Color: To be selected by Architect from manufacturer's standard colors.
 - 3. Joint Width, Minimum: 1/8 inch.
 - 4. Joint Width, Maximum: 1/2 inch.
 - 5. Joint Depth: Provide product suitable for joints from 1/8 inch to 1 inch in depth excluding space for backer rod.
 - 6. Products:
 - a. ARDEX Engineered Cements; ARDEX ARDISEAL RAPID PLUS: www.ardexamericas.com/#sle.
 - b. Euclid Chemical Company; EUCO QWIKjoint UVR: www.euclidchemical.com/#sle.
 - c. Nox-Crete Inc; DynaFlex JF-85: www.nox-crete.com/#sle.
 - d. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.06 ACCESSORIES

- A. Sealant Backing Materials, General: Materials placed in joint before applying sealants; assists sealant performance and service life by developing optimum sealant profile and preventing three-sided adhesion; type and size recommended by sealant manufacturer for compatibility with sealant, substrate, and application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.
- C. Masking Tape: Self-adhesive, nonabsorbent, nonstaining, removable without adhesive residue, and compatible with surfaces adjacent to joints and sealants.
- D. Joint Cleaner: Noncorrosive and nonstaining type, type recommended by sealant manufacturer; compatible with joint forming materials.
- E. Primers: Type recommended by sealant manufacturer to suit application; nonstaining.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Preinstallation Adhesion Testing: Install a sample for each test location indicated in the test plan.
 - 1. Test each sample as specified in PART 1 under QUALITY ASSURANCE article.
 - 2. Notify Architect of date and time that tests will be performed, at least seven days in advance.
 - 3. Arrange for sealant manufacturer's technical representative to be present during tests.
 - 4. Record each test on Preinstallation Adhesion Test Log as indicated.
 - 5. If any sample fails, review products and installation procedures, consult manufacturer, or take other measures that are necessary to ensure adhesion; retest in a different location; if unable to obtain satisfactory adhesion, report to Architect.
 - 6. After completion of tests, remove remaining sample material and prepare joints for new sealant installation.

3.02 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.03 INSTALLATION

- A. Install this work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Provide joint sealant installations complying with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve the following, unless otherwise indicated:

1. Width/depth ratio of 2:1.
 2. Neck dimension no greater than 1/3 of the joint width.
 3. Surface bond area on each side not less than 75 percent of joint width.
- D. Install bond breaker backing tape where backer rod cannot be used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- F. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- G. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.
- H. Concrete Floor Joint Filler: After full cure, shave joint filler flush with top of concrete slab.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. District will employ an independent testing agency to perform field quality control inspection and testing as specified in PART 1 under QUALITY ASSURANCE article.
- C. Non-Destructive Adhesion Testing: If there are any failures in first 100 linear feet, notify Architect immediately.
- D. Destructive Adhesion Testing: If there are any failures in first 1,000 linear feet, notify Architect immediately.
- E. Remove and replace failed portions of sealants using same materials and procedures as indicated for original installation.
- F. Repair destructive test location damage immediately after evaluation and recording of results.

3.05 POST-OCCUPANCY

- A. Post-Occupancy Inspection: Perform visual inspection of entire length of project sealant joints at a time that joints have opened to their greatest width, i.e., at low temperature in thermal cycle. Report failures immediately and repair them.

END OF SECTION

SECTION 08 00 01
DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Preliminary schedule of door hardware sets for swinging as indicated on drawings.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware: Requirements to comply with in coordination with this section.

1.03 REFERENCE STANDARDS

- A. BHMA (CPD) - Certified Products Directory; Current Edition.
B. BHMA A156.3 - Exit Devices; 2020.
C. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
D. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
E. BHMA A156.18 - Deep Foundation Institute Technical Manual; Glossary of Foundation Terms; 1981.
F. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
B. Comply with submittal requirements as indicated in Section 08 71 00.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Only manufacturers listed in Door Hardware Schedule or Section 08 71 00 are considered acceptable, unless noted otherwise.

ITEM	MANUFACTURER	ACCEPTABLE ALTERNATE
Hinges	(IVE) Ives	Hager
Continuous Hinges	(IVE) Ives	Pemko
Pivots	(IVE) Ives	Rixson
Floor Closers	(RIX) Rixson	Dorma
Key System	(SCH) Schlage	Owner standard
Mechanical Locks	(SCH) Schlage	Owner standard
Electronic Locks	(SCE) Schlage Electronics	Owner standard
Exit Devices	(VON) Von Duprin	Owner standard
Closers	(LCN) LCN	Owner standard
Auto Flush Bolts	(IVE) Ives	DCI
Coordinators	(IVE) Ives	DCI

ITEM	MANUFACTURER	ACCEPTABLE ALTERNATE
Silencers	(IVE) Ives	Rockwood, Trimco
Push & Pull Plates	(IVE) Ives	Rockwood, Trimco
Kickplates	(IVE) Ives	Rockwood, Trimco
Stops & Holders	(IVE) Ives	Rockwood, Trimco
Overhead Stops	(GLY) Glynn-Johnson	ABH
Thresholds	(ER) ero	NGP, Pemko
Seals & Bottoms	(ER) ero	NGP, Pemko
Key Cabinets	(LUN) Lund	TelKee
Aluminum Door Locks	(ADA) Adams Rite	None

- B. Obtain each type of door hardware as indicated from a single manufacturer and single supplier.
- C. Products are listed and certified compliant with specified standards by BHMA (CPD).
- D. Manufacturer's Abbreviations: Coordinate with manufacturers listed in Section 08 71 00.
 - 1. GLY - Glynn Johnson, Allegion, PLC.
 - 2. IVE - Ives, Allegion, PLC.
 - 3. KNX/KNO - Knox Company.
 - 4. LCN - LCN Commercial Division, Allegion, PLC.
 - 5. SCE - Schlage Electronic Security, Allegion, PLC
 - 6. SCH/SC - Schlage Lock Company, Allegion, PLC.
 - 7. VON - Von Duprin, Allegion, PLC..
 - 8. ER - ero Industries, Inc., Allegion, PLC.
 - 9. TBD - To be determined.
 - 10. B/O, BYO, OT - By Others.

2.02 DESCRIPTION

- A. Door hardware sets provided represent the design intent, they are only a guideline and should not be considered a detailed or complete hardware schedule.
 - 1. Provide door hardware item(s) as required for similar purposes, even when item is not listed for a door in Door Hardware Schedule.
 - 2. Necessary items that are not included in a Hardware Set should be added and have the appropriate additional hardware as required for proper application and functionality.
 - 3. Door hardware supplier is responsible for providing proper size and hand of door for products required in accordance with Door Hardware Schedule and as indicated on drawings.
 - 4. Quantities listed are for each Pair (PR) of doors, or for each Single (SGL) door, as indicated in hardware sets.

2.03 LOCK FUNCTION CODES

- A. Function Codes for Cylindrical Locks: Complying with BHMA A156.5.
- B. Function Codes for Mortise Locks: Complying with BHMA A156.13.
- C. Function Codes for Exit Devices: Complying with BHMA A156.3.

- A. Finishes: Complying with BHMA A156.18.

PART 3 EXECUTION

3.01 DOOR HARDWARE SCHEDULE

- A. Organize listing of door hardware components within each hardware set in compliance with 10-Part scheduling sequence indicated in DHI (H&S), unless otherwise indicated.
- B. See door schedule in drawings for hardware set assignments.
- C. Do not order hardware until Finished Hardware has been reviewed and approved by Architect's hardware consultant.
- D. Provide Factory order numbers for all products supplied on this project as part of close out documents for District's warranty records.
- E. Any door count quantity shown in the HW set listings is for reference only. Verify all door quantities with the Architectural Drawings.
- F. Hardware Sets:

OVERTUR 1109466 V1 /OPT0384347

HARDWARE GROUP NO. 01

For use on Door #(s):

100

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	US28	IVE
1	EA	CLASSROOM SECURITY W/ INSIDE INDICATOR	L9071T 06A IS-LOC	626	SCH
2	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	328AA-S AT JAMB LEGS	AA	ZER
1	SET	GASKETING	429AA-S AT HEAD	AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	39A	A	ZER

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
 SANTA MARIA-BONITA SCHOOL DISTRICT
 SANTA MARIA, CALIFORNIA
 HARDWARE GROUP NO. 02

DLR GROUP: 75-24119-00
 DECEMBER 16, 2024
 CONSTRUCTION DOCUMENTS

For use on Door #(s):

101 110

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	US28	IVE
1	EA	CORRIDOR LOCK W/ OUTSIDE INDICATOR W/ INSIDE INDICATOR	L9456T 06A 09-544 OS-OCC IS- LOC XL13-439	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	328AA-S AT JAMB LEGS	AA	ZER
1	SET	GASKETING	429AA-S AT HEAD	AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	39A	A	ZER

HARDWARE GROUP NO. 03

For use on Door #(s):

102A 102B 104A 104B 106A 106B
 108A 108B 112A 112B 114A 114B
 116A 116B

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	US28	IVE
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
1	EA	MORTISE CYLINDER	20-061 XQ11-948 36-083	626	SCH
2	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	DOOR PULL	VR910 NL	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	GASKETING	328AA-S AT JAMB LEGS	AA	ZER
1	SET	GASKETING	429AA-S AT HEAD	AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	39A	A	ZER

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
 SANTA MARIA-BONITA SCHOOL DISTRICT
 SANTA MARIA, CALIFORNIA
 HARDWARE GROUP NO. 04

DLR GROUP: 75-24119-00
 DECEMBER 16, 2024
 CONSTRUCTION DOCUMENTS

For use on Door #(s):

103 105 107 109

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	PASSAGE SET	L9010 06A	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 05

For use on Door #(s):

111 120

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	US28	IVE
1	EA	STOREROOM LOCK	L9080T LLL 06A L283-150	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	DOOR PULL	VR900 LLP	630	IVE
1	EA	SURFACE CLOSER	4111 EDA	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS18S	BLK	IVE
1	EA	GASKETING	328AA-S AT JAMB LEGS	AA	ZER
1	SET	GASKETING	429AA-S AT HEAD	AA	ZER
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	39A	A	ZER

HARDWARE GROUP NO. 06

For use on Door #(s):

111A

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	3CB1 4.5 X 4.5	652	IVE
1	EA	STOREROOM LOCK	L9080T 06A	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	SURFACE CLOSER	4110 EDA STD SRT	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	FLOOR STOP	FS436/FS438 AS REQUIRED	626	IVE
3	EA	SILENCER	SR64	GRY	IVE

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
 SANTA MARIA-BONITA SCHOOL DISTRICT
 SANTA MARIA, CALIFORNIA
 HARDWARE GROUP NO. 07

DLR GROUP: 75-24119-00
 DECEMBER 16, 2024
 CONSTRUCTION DOCUMENTS

For use on Door #(s):

113 115 117

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
3	EA	HINGE	3CB1HW 4.5 X 4.5	652	IVE
1	EA	PRIVACY LOCK W/ OUTSIDE INDICATOR W/ INSIDE INDICATOR	L9040 06A 09-544 OS-OCC IS- LOC	626	SCH
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
3	EA	SILENCER	SR64	GRY	IVE

HARDWARE GROUP NO. 08

For use on Door #(s):

118 119

Provide each SGL door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
1	EA	CONT. HINGE	224XY	US28	IVE
1	EA	CLASSROOM HOLDBK	L9076T LLL 06A L283-150	626	SCH
1	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	DOOR PULL	VR900 LLP	630	IVE
1	EA	SURFACE CLOSER	4111 SCUSH	689	LCN
1	EA	KICK PLATE	8400 10" X 2" LDW B-CS	630	IVE
1	EA	THRESHOLD	THRESHOLD AS DETAILED		
1	EA	DOOR SWEEP	39A	A	ZER
3	EA	SILENCER	SR64	GRY	IVE

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
 SANTA MARIA-BONITA SCHOOL DISTRICT
 SANTA MARIA, CALIFORNIA
 HARDWARE GROUP NO. G1

DLR GROUP: 75-24119-00
 DECEMBER 16, 2024
 CONSTRUCTION DOCUMENTS

For use on Door #(s):

G1

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	SET	CHAIN LINK BRKT (AS REQUIRED)	CLB-MAMMOTH		LOC
2	SET	GATE HINGE/CLOSER	MAMMOTH-180	689	LOC
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-EO	626	VON
1	EA	PANIC HARDWARE	CDSI-PA-AX-98-NL-OP-110MD	626	VON
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
2	EA	MORTISE CYLINDER	20-061 XQ11-948 36-083	626	SCH
3	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	FLOOR STOP	FS18L	BLK	IVE

CENTER POST REQUIRED FOR LATCHING OF PANIC HARDWARE
 CENTER POST BY GATE MANUFACTURER

HARDWARE GROUP NO. G2

For use on Door #(s):

G2 G3 G4 G5 G6 G7
 G8

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
4	EA	GATE PIVOT/HINGE BY GATE MANUFACTURER	SUPPLIED BY GATE MANUFACTURER	GAL	MIS
1	SET	CANE BOLT	BY GATE FABRICATOR	GAL	B/O
1	EA	GATE FORK LATCH	AS DETAILED	GAL	MIS

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA
HARDWARE GROUP NO. G3

DLR GROUP: 75-24119-00
DECEMBER 16, 2024
CONSTRUCTION DOCUMENTS

For use on Door #(s):

G3

Provide each PR door(s) with the following:

QTY		DESCRIPTION	CATALOG NUMBER	FINISH	MFR
2	SET	CHAIN LINK BRKT (AS REQUIRED)	CLB-MAMMOTH		LOC
2	SET	GATE HINGE/CLOSER	MAMMOTH-180	689	LOC
1	EA	RIM CYLINDER	20-057 ICX	626	SCH
2	EA	MORTISE CYLINDER	20-061 XQ11-948 36-083	626	SCH
3	EA	FSIC CORE	23-030 EV D	626	SCH
1	EA	DOOR PULL	VR910 DT	630	IVE
1	EA	DOOR PULL	VR910 NL	630	IVE
2	EA	FLOOR STOP	FS18L	BLK	IVE

CENTER POST BY GATE MANUFACTURER

Maintenance Materials, provide the following:

As-built hardware schedule

Copies of warranty information for each hardware type

Binder of catalog cuts or complete catalog sections of items used, installation and maintenance/adjustment information.

Collection of tools that were included with the hardware: wrenches, drivers, etc.

END OF SECTION

SECTION 08 11 13 HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-fire-rated hollow metal doors and frames.
- B. Hollow metal frames for wood doors.
- C. Fire-rated hollow metal doors and frames.
- D. Thermally insulated hollow metal doors with frames.
- E. Hollow metal borrowed lites glazing frames.
- F. Accessories, including glazing.

1.02 RELATED REQUIREMENTS

- A. Section 08 71 00 - Door Hardware.
- B. Section 08 80 00 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 91 13 - Exterior Painting: Field painting.
- D. Section 09 91 23 - Interior Painting: Field painting.

1.03 ABBREVIATIONS AND ACRONYMS

- A. ANSI: American National Standards Institute.
- B. HMMA: Hollow Metal Manufacturers Association.
- C. NAAMM: National Association of Architectural Metal Manufacturers.
- D. NFPA: National Fire Protection Association.
- E. SDI: Steel Door Institute.
- F. UL: Underwriters Laboratories.

1.04 REFERENCE STANDARDS

- A. 12-7-4 CA Ref Stds - California Referenced Standards Code Chapter 12-7-4 Fire Resistive Standards; 2016.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames; 2022.
- D. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames and Frame Anchors; 2022.
- E. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames; 2020.
- F. ANSI/SDI A250.8 - Specifications for Standard Steel Doors and Frames (SDI-100); 2023.
- G. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 2020.
- H. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2023.
- I. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.

- J. ASTM A1008/A1008M - Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Required Hardness, Solution Hardened, and Bake Hardenable; 2023, with Editorial Revision.
- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength; 2023.
- L. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- M. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- N. CBC - California Building Code; Current Adopted Edition.
- O. ITS (DIR) - Directory of Listed Products; Current Edition.
- P. NAAMM HMMA 820 TN03 - Guidelines for Glazing of Hollow Metal Transoms, Sidelights and Windows; 2007.
- Q. NAAMM HMMA 830 - Hardware Selection for Hollow Metal Doors and Frames; 2002.
- R. NAAMM HMMA 831 - Hardware Locations for Hollow Metal Doors and Frames; 2011.
- S. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames; 2017.
- T. NAAMM HMMA 861 - Guide Specifications for Commercial Hollow Metal Doors and Frames; 2014.
- U. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- V. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- W. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- X. SDI 117 - Manufacturing Tolerances for Standard Steel Doors and Frames; 2023.
- Y. UL (DIR) - Online Certifications Directory; Current Edition.
- Z. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- AA. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced standards/guidelines.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and any indicated finish requirements.
 - 1. Show fabrication and installation of steel doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
 - 2. Provide schedule of doors and frames using same reference numbers for details and openings as those indicated on Drawings.
 - 3. Indicate coordination of glazing frames and stops with glass and glazing requirements.

- D. Installation Instructions: Manufacturer's published instructions, including any special installation instructions relating to this project.
- E. Manufacturer's Certificate: Certification that products meet or exceed specified requirements.
- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- C. Maintain at project site copies of reference standards relating to installation of products specified.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Provide packaging such as cardboard, or other containers to protect surfaces of hollow metal doors. Strap welded frames together in pairs with head of one unit inverted or provide temporary spreaders fastened to the bottom of each frame.
- B. Comply with NAAMM HMMA 840 or ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
 - 1. Store doors and frames on platforms under cover.
 - 2. Store doors and frames in dry storage spaces, with adequate ventilation, free from dust, and which permits easy access for inspection and handling.
 - 3. Avoid using nonvented plastic or canvas shelters that create a humidity chamber.
 - 4. If the wrapper on the door becomes wet, remove the wrapper.
- C. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion and adverse effects on factory applied painted finish.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Fire-Rated Door Assemblies: Meet the requirements of the California Building Code (CBC), Title 24, Part 2, Chapter 7 - Fire Resistance Rated Construction for the fire resistive ratings indicated, and which are labeled by Underwriter's Laboratories, Factory Mutual, or other testing agency acceptable to the State Fire Marshal.
 - 1. Fire-rated door and frame construction: Conform to NFPA 252, applicable CBC Standard [12-7-4 CA Ref Stds](#) and requirements of Factory Mutual System (FM). Labels on fire-rated doors and frames shall identify FM listing approval. Comply with UL 10B.
 - 2. Fire-rated door and frame installation: NFPA 80 - Fire Door Installation and applicable CBC Standards for fire rated class indicated.
 - 3. Fire-rated doors, intumescent seals: UL 10C compliant. If intumescent seals are required for the fire labeled assembly, furnish flush with door edge type seals or kerfed in frame type seals. Surface applied adhesive seals will not be accepted. Coordinate frame fabrication to allow use of kerfed in frame type seal options.

4. Temperature rise rating: At exit stairwell enclosures, exit passageways, and horizontal exits, provide doors which are labeled for a maximum transmitted temperature end point not to exceed 450 degrees above ambient at the end of 30 minutes of fire exposure.
5. Oversize fire-rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to the State Fire Marshal that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
6. Where fire resistive doors are indicated to be equipped with louvers, provide fusible link type louvers acceptable to the testing agency labeling the fire door and frame assembly.
 - a. Exception: Louvers are not to be used in "S" rated door assemblies. CBC Section 710.5.2.1 and 716.2.2.1.1.
7. All exit/access doorways and other doors opening into a fire rated corridor shall be protected by tight-fitting smoke and draft control assemblies having a fire rating of not less than 20 minutes when tested in accordance with CBC Standards and shall be labeled accordingly per CBC section 716.2.9.

2.02 MANUFACTURERS

A. Hollow Metal Doors and Frames:

1. Ceco Door, an Assa Abloy Group company: www.assaabloydss.com.
2. Curries, an Assa Abloy Group company: www.assaabloydss.com.
3. DCI Hollow Metal; www.dcihollowmetal.com
4. Republic Doors, an Allegion brand: www.republicdoor.com/#sle.
5. Steelcraft, an Allegion brand: www.allegion.com/sle.
6. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.03 PERFORMANCE REQUIREMENTS

A. Requirements for Hollow Metal Doors and Frames:

1. Steel Sheet: Comply with one or more of the following requirements; galvanized steel complying with ASTM A653/A653M, cold-rolled steel complying with ASTM A1008/A1008M, or hot-rolled pickled and oiled (HRPO) steel complying with ASTM A1011/A1011M, commercial steel (CS) Type B, for each.
2. Accessibility: Comply with ADA Standards and CBC Chapter 11B.
3. Exterior Door Top Closures: Flush end closure channel, with top and door faces aligned.
4. Door Edge Profile: Beveled, both sides.
5. Typical Door Face Sheets: Flush. Smooth .
6. Glazed Lights: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings. Style: Manufacturer's standard.
7. Hardware Preparations, Selections and Locations: Comply with NAAMM HMMA 830 and NAAMM HMMA 831 or BHMA A156.115 and ANSI/SDI A250.8 (SDI-100) in accordance with specified requirements.
8. Zinc Coating for Typical Interior and/or Exterior Locations: Provide metal components zinc-coated (galvanized) and/or zinc-iron alloy-coated (galvanized) by the hot-dip process in accordance with ASTM A653/A653M, with manufacturer's standard coating thickness, unless noted otherwise for specific hollow metal doors and frames.

- a. Based on SDI Standards: Provide at least A40/ZF120 (galvannealed) when necessary, coating not required for typical interior door applications, and at least A60/ZF180 (galvannealed) for corrosive locations.
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.04 HOLLOW METAL DOORS

- A. Door Finish: Factory primed and field finished.
- B. Exterior Doors: Thermally insulated.
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 3 - Extra Heavy-duty.
 - b. Physical Performance Level A, 1,000,000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 16 gauge, 0.053 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 - 2. Core Material: Vertical steel stiffeners with fiberglass batts.
 - 3. Door Thermal Resistance: R-Value of 9.9, minimum, for installed thickness of polyisocyanurate.
 - a. Doors with no glazing or less than 50 percent glazed shall comply with the required U-factor not greater than the applicable value (0.70) in Subchapter Table 140.3-B, C, or D. California Energy Code Section 140.3 (a) 7.
 - 4. Door Thickness: 1-3/4 inches, nominal.
 - 5. Weatherstripping: Refer to Section 08 71 00.
 - a. Maximum Air Leakage, ASTM E283: 0.30cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity). California Energy Code Section 110.6(a) 1.
- C. Interior Doors, Non-Fire-Rated:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).
 - a. Level 2 - Heavy-duty.
 - b. Physical Performance Level B 500 000 cycles; in accordance with ANSI/SDI A250.4.
 - c. Model 2 - Seamless.
 - d. Door Face Metal Thickness: 20 gage, 0.032 inch, minimum.
 - e. Zinc Coating: A60/ZF180 galvannealed coating; ASTM A653/A653M.
 - 2. Door Core Material: Manufacturers standard core material/construction and in compliance with requirements.
 - 3. Door Thickness: 1-3/4 inches, nominal.
- D. Fire-Rated Doors:
 - 1. Based on SDI Standards: ANSI/SDI A250.8 (SDI-100).

- a. Level 2 - Heavy-duty.
- b. Physical Performance Level C, 250,000 cycles; in accordance with ANSI/SDI A250.4.
- c. Model 2 - Seamless.
- d. Door Face Metal Thickness: 18 gage, 0.042 inch, minimum.
2. Fire Rating: As indicated on Door Schedule, tested in accordance with UL 10C and NFPA 252 ("positive pressure fire tests").
 - a. Provide units listed and labeled by UL (DIR) or ITS (DIR).
 - b. Permanently attach fire rating label to each fire rated unit. CBC 716.2.9.
3. Door Core Material: Manufacturers standard core material/construction in compliance with requirements.
 - a. Fabricate to the requirements of NFPA 252 for the hourly rates indicated.
4. Door Thickness: 1-3/4 inches, nominal.

2.05 HOLLOW METAL FRAMES

- A. Comply with standards and/or custom guidelines as indicated for corresponding door in accordance with applicable door frame requirements.
- B. Frame Finish: Factory primed and field finished.
 1. Provide compatible primer for Section 09 96 00 - High-Performance Coatings.
- C. Exterior Door Frames: Fully welded.
 1. Galvanizing: Components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A40/ZF120 coating.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
 3. Weatherstripping: Separate, see Section 08 71 00.
- D. Interior Door Frames, Non-Fire Rated: Full profile/continuously welded type.
 1. Frame Metal Thickness: 18 gage, 0.042 inch, minimum.
- E. Door Frames, Fire-Rated: Full profile/continuously welded type.
 1. Fire Rating: Same as door, labeled.
 2. Frame Metal Thickness: 16 gage, 0.053 inch, minimum.
- F. Frames for Wood Doors: Comply with frame requirements in accordance with corresponding door.
- G. Mullions for Pairs of Doors: Fixed, except where removable is indicated, with profile similar to jambs.
- H. Frames for Interior Glazing, Borrowed Lights, Sidelights, and Exterior Windows: Construction and face dimensions to match door frames, and as indicated on drawings.
 1. Full formed, concealed fastenings, welded corners, fabricated as for door frames.
 2. Shapes as detailed and scheduled on Drawings.
 3. Provide single rabbet frames at all Interior Glazing, Borrowed Lights, Sidelights, and Exterior Windows.
 4. Cold rolled steel with anchors same as for door frames for respective wall condition.
 - a. Exception:

- 1) Jamb anchors located within 6 inches of head and sill plus spaced not more than 24 inches on center.
 - 2) Head and sill anchors located within 6 inches of jambs plus spaced not more than 24 inches on center.
- I. Frames Wider than 48 inches: Reinforce with steel channel fitted tightly into frame head, flush with top.

2.06 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.
1. Exterior Steel Doors and Door Frames: Comply with requirements for primer for finish coats.
 2. Interior Steel Doors and Rolled Steel Door Frames: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as a base for specified finish paints.
- B. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15 mil, 0.015 inch dry film thickness (DFT) per coat; provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.
- C. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction.
- D. Field Applied Finish Painting: As specified in:
1. Section 09 91 13 - Exterior Painting.
 2. Section 09 91 23 - Interior Painting.
 3. Exterior Doors (Abuse Resistant): Section 09 96 00 - High-Performance Coatings.

2.07 ACCESSORIES

- A. Glazing: As specified in Section 08 80 00, factory installed.
1. Glazed Openings: Comply with CBC Section 716.3.2.1.2 and Chapter 24.
 - a. Vision Panel: Factory installed.
 - 1) Application: Provide at all new classroom, office, corridor and other teacher and staff occupied spaces.
 - 2) Size (WxH): 6 by 37 inches, unless indicated otherwise on Drawings.
- B. Removable Stops: Formed sheet steel, shape as indicated on drawings, mitered or butted corners; prepared for countersink style tamper proof screws.
1. Glazing Stops: Channel glazing stops, completely fit ready for removal and glazing at site.
 2. Place on exterior side with tamper proof screws.
- C. Astragals for Double Doors: Specified in Section 08 71 00.
- D. Supports and Anchors: Fabricate of not less than 16 gage sheet steel; galvanized where used with galvanized frames or at exterior, damp or wet locations.
1. Anchors: Provide in accordance with ANSI/SDI A250.11.
 - a. Anchors at fire rated frames shall also conform to UL 10B.
 - b. Provide one floor anchor and the number of wall anchors listed below welded into each jamb member.
 - 1) Number of anchors at:
 - (a) Concrete or Masonry: Typically 3, and 4 for doors over 7'-0" high.

- (b) Steel Stud Partitions: Typically 4, and 5 for doors over 7'-0" high.
- c. Wall anchors shall be of type indicated for the specific wall condition and of same material specified for frames.
- d. Provide head anchors welded into head member as recommended by the frame manufacturer.
- e. All anchors shall be 16 gage minimum for galvanized frames and 16 gage minimum for cold or hot rolled steel frames.
- f. Provide "Z" spacer type anchors for all wood studs.
- 2. Punch and dimple jambs within 6 inches of bottom for attachment to concrete stem walls where occur.
- E. Silencers: Resilient rubber, fitted into drilled hole; provide three on strike side of single door, three on center mullion of pairs, and two on head of pairs without center mullions.
- 1. Omit silencers where head and jamb bulb-type weatherstripping or sound seals are to be installed and omit where in violation of fire rating. Silencers are specified in Section 08 71 00 - Door Hardware.
- F. Temporary Frame Spreaders: Provide for factory- or shop-assembled frames.
- G. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where items are to be built into exterior walls, hot-dip galvanize in compliance with ASTM A153/A153M, Class C or D as applicable.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.02 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.03 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and related requirements of specified door and frame standards or custom guidelines indicated.
- B. In addition, install fire rated units in accordance with NFPA 80 and their listing.
 - 1. Provide clearances as specified in NFPA 80, NFPA 105, and as required by California Building Code (CBC).
- C. Coordinate frame anchor placement with wall construction.
- D. Install door hardware as specified in Section 08 71 00.
 - 1. Comply with recommended practice for hardware placement of doors and frames in accordance with ANSI/SDI A250.6 or NAAMM HMMA 861.
- E. Coordinate installation of electrical connections to electrical hardware items.
- F. Welded Steel Frames Installation:
 - 1. Install frame solid in the wall, plumb and square, with proper opening width and height.
 - a. Dry-pack void when frame set in place.

2. Fasten clip angles to floor construction and brace frames so as to retain their position and clearance during construction of adjacent Work. Attach structural overhead bracing securely to structure above, as required.
 3. Install anchors for connection to concrete/masonry at each jamb (minimum 3 per jamb).
 4. Install anchors for stud partitions on hinge jamb immediately above each hinge reinforcing plate and below the top hinge reinforcement (minimum 4 per jamb) and locate anchors directly opposite on the strike jamb.
 5. Comply with requirements for fire-rated assembly, including filling frame with solid portland cement grout or firestopping material, as detailed.
- G. Doors Installation, General: Hang doors and adjust for proper clearances and operation. Refer to Section 08 71 00 - Door Hardware for hardware requirements.
- H. For waterproofing of hollow metal window frames, follow NAAMM HMMA 820 TN03.
- I. Touch up damaged factory finishes.

3.04 REPAIRS

- A. Make repairs only if permitted by Architect. Otherwise, replace damaged components.
- B. Fill surface depressions with metallic paste filler, allow to thoroughly cure, sand flush, and smooth for an invisible appearance with adjacent metal surfaces.
- C. Sand smooth all rusted areas.
- D. Repair galvanized surfaces with specified repair compound.
- E. Apply touch-up paint using air drying primer compatible with shop-applied finish.

3.05 TOLERANCES

- A. Flush Steel Door Installation Tolerances: Fit hollow metal doors accurately in frames, within clearances specified in ANSI/SDI A250.8.
- B. Clearances Between Door and Frame: Comply with related requirements of specified frame standards or custom guidelines indicated in accordance with SDI 117 or NAAMM HMMA 861.
- C. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.06 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.07 CLEANING AND PROTECTION

- A. Prime Coat Touch-up: Immediately after installation, sand smooth all corroded (rusted), damaged and deteriorated areas of prime coat and apply touch-up coat of compatible air-drying primer.
- B. Protection: Protect installed frames and doors from damage.
 1. Provide protective coverings and other devices as necessary, in conformance to requirements specified in Section 01 50 00 - Temporary Facilities and Controls.
 2. Remove protective devices from prefinished components for Substantial Completion review.
- C. Final Adjustments: Check and readjust operating hardware items, leaving steel doors and frames undamaged and in complete and proper operating condition.
- D. Cleaning: Clean doors and frames of surface contaminants detrimental to proper application of field-applied finishes.

3.08 SCHEDULE - SEE DRAWINGS

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 14 16 FLUSH WOOD DOORS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Flush wood doors; flush configuration; fire rated and non-rated.

1.02 RELATED REQUIREMENTS

- A. Section 08 11 13 - Hollow Metal Doors and Frames.
- B. Section 08 71 00 - Door Hardware.
- C. Section 08 80 00 - Glazing.
- D. Section 09 91 23 - Interior Painting: Field finishing of doors.

1.03 REFERENCE STANDARDS

- A. 12-7-4 CA Ref Stds - California Referenced Standards Code Chapter 12-7-4 Fire Resistive Standards; 2016.
- B. ASTM E413 - Classification for Rating Sound Insulation; 2022.
- C. AWI/AWMAC/WI (AWS) - Architectural Woodwork Standards, 2nd Edition; 2014, with Errata (2016).
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards; 2021, with Errata.
- E. NFPA 80 - Standard for Fire Doors and Other Opening Protectives; 2022.
- F. NFPA 105 - Standard for Smoke Door Assemblies and Other Opening Protectives; 2022.
- G. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; 2022.
- H. UL 10B - Standard for Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- I. UL 10C - Standard for Positive Pressure Fire Tests of Door Assemblies; Current Edition, Including All Revisions.
- J. UL 1784 - Standard for Air Leakage Tests of Door Assemblies; Current Edition, Including All Revisions.
- K. WDMA I.S. 1A - Interior Architectural Wood Flush Doors; 2021, with Errata (2022).
- L. WI (MCP) - Monitored Compliance Program (MCP); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate door core materials and construction; veneer species, type and characteristics.
- C. Shop Drawings: Show doors and frames, elevations, sizes, types, swings, undercuts, beveling, blocking for hardware, factory machining, factory finishing, cutouts for glazing and other details.
 - 1. Provide information as required by AWMAC/WI (NAAWS).
 - 2. Include certification program label and fire rated doors.

- D. Samples: Submit two samples of door veneer, 12 by 12 inches in size illustrating wood grain, stain color, and sheen.
- E. Certificate: Submit labels and certificates required by quality assurance and quality control programs.
- F. Test Reports: Show compliance with specified requirements for the following:
 - 1. Sound-retardant doors and frames; sealed panel tests are not acceptable.
- G. Manufacturer's Installation Instructions: Indicate special installation instructions.
- H. Manufacturer's qualification statement.
- I. Installer's qualification statement.
- J. Specimen warranty.
- K. Warranty, executed in District's name.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of the specified door quality standard on site for review during installation and finishing.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with not less than three years of documented experience.
 - 1. Company with at least one project within past five years with value of woodwork within at least 20 percent of cost of woodwork for this project.
 - 2. Accredited participant in the specified certification program prior to the commencement of fabrication and throughout the duration of the project.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- D. Woodwork Quality Assurance Program:
 - 1. Comply with WI (MCP) woodwork association quality assurance service/program in accordance with requirements for work specified in this section; www.woodworkinstitute.com/#sle.
 - 2. Provide labels or certificates indicating that installed work will comply with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by quality assurance program.
 - 4. Provide designated labels on installed products as required by quality assurance program.
 - 5. Submit documentation upon completion of installation that verifies this work is in compliance with specified requirements.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Package, deliver and store doors in accordance with specified quality standard.
- B. Accept doors on site in manufacturer's packaging, and inspect for damage.
- C. Protect doors with resilient packaging sealed with heat shrunk plastic; do not store in damp or wet areas or areas where sunlight might bleach veneer; seal top and bottom edges with tinted sealer if stored more than one week, and break seal on site to permit ventilation.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide manufacturer's warranty on interior doors for the life of the installation. Complete forms in District's name and register with manufacturer.

1. Include coverage for delamination of veneer, warping beyond specified installation tolerances, defective materials, and telegraphing core construction.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Fire-Rated Door Assemblies: Meet the requirements of the California Building Code (CBC), Title 24, Part 2, Chapter 7 - Fire Resistance Rated Construction for the fire resistive ratings indicated, and which are labeled by Underwriter's Laboratories, Factory Mutual, or other testing agency acceptable to the State Fire Marshal.
 1. Fire-rated door and frame construction: Conform to NFPA 252, applicable CBC Standard [12-7-4 CA Ref Stds](#) and requirements of Factory Mutual System (FM). Labels on fire-rated doors and frames shall identify FM listing approval. Comply with UL 10B.
 2. Fire-rated door and frame installation: NFPA 80 - Fire Door Installation and applicable CBC Standards for fire rated class indicated.
 3. Fire-rated doors, intumescent seals: UL 10C compliant. If intumescent seals are required for the fire labeled assembly, furnish flush with door edge type seals or kerfed in frame type seals. Surface applied adhesive seals will not be accepted. Coordinate frame fabrication to allow use of kerfed in frame type seal options.
 4. Temperature rise rating: At exit stairwell enclosures, exit passageways, and horizontal exits, provide doors which are labeled for a maximum transmitted temperature end point not to exceed 450 degrees above ambient at the end of 30 minutes of fire exposure.
 5. Oversize fire-rated door assemblies: For units exceeding sizes of tested assemblies, provide certification by a testing agency acceptable to the State Fire Marshal that doors comply with standard construction requirements for tested and labeled fire-rated door assemblies except for size.
 6. Where fire resistive doors are indicated to be equipped with louvers, provide fusible link type louvers acceptable to the testing agency labeling the fire door and frame assembly.
 - a. Exception: Louvers are not to be used in "S" rated door assemblies. CBC Section 710.5.2.1 and 716.2.2.1.1.
 7. All exit/access doorways and other doors opening into a fire rated corridor shall be protected by tight-fitting smoke and draft control assemblies having a fire rating of not less than 20 minutes when tested in accordance with CBC Standards and shall be labeled accordingly per CBC section 716.2.2.1.

2.02 MANUFACTURERS

- A. Wood Veneer Faced Doors:
 1. Haley Brothers: www.haleybros.com/#sle.
 2. Masonite Architectural; Aspiro Select Wood Veneer Doors: www.architectural.masonite.com/#sle.
 3. Oregon Door: www.oregondoor.com.
 4. VT Industries, Inc: www.vtindustries.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 DOORS

- A. Doors: See drawings for locations and additional requirements.

1. Quality Standard: Custom Grade, Extra Heavy Duty performance, in accordance with AWMAC/WI (NAAWS) or WDMA I.S. 1A.
2. Wood Veneer Faced Doors: 5-ply unless otherwise indicated.
- B. Interior Doors: 1-3/4 inches thick unless otherwise indicated; flush construction.
 1. Provide solid core doors at each location.
 2. Fire Rated Doors: Tested to 60 minutes and ratings as indicated on drawings in accordance with UL 10C - Positive Pressure; Underwriters Laboratories Inc. (UL) or Intertek/Warnock Hersey (WHI) labeled without any visible seals when door is open.
 - a. Comply with CBC Section 716.2.3.
 3. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide door assemblies tested in accordance with UL 1784 with maximum air leakage of 3.0 cfm per sq ft of door opening at 0.10 inch wg pressure at both ambient and elevated temperatures for "S" label; no additional gasketing or edge sealing allowed.
 - a. Comply with CBC Section 716.9.3.
 4. Smoke and Draft Control Doors (Indicated as "S" on Drawings): In addition to required fire rating, provide flush wood door assemblies in compliance with WDMA I.S. 1A requirements for "S" label; no additional gasketing or edge sealing allowed.
 5. Sound Retardant Doors: Minimum STC of 35, calculated in accordance with ASTM E413, tested in accordance with ASTM E90.
 6. Wood veneer facing with factory transparent finish as indicated on drawings.

2.04 DOOR AND PANEL CORES

- A. Non-Rated Solid Core and 20 Minute Rated Doors: Type staved lumber core (SLC), plies and faces as indicated.
- B. Fire-Rated Doors: Mineral core type, with fire resistant composite core (FD), plies and faces as indicated above; with core blocking as required to provide adequate anchorage of hardware without through-bolting.
- C. Sound-Rated Doors: Equivalent to type, with particleboard core (PC) construction as required to achieve STC rating specified; plies and faces as indicated above.

2.05 DOOR FACINGS

- A. Veneer Facing for Transparent Finish: Architect selected, veneer grade in accordance with quality standard indicated, plain sliced (flat cut), with slip match between leaves of veneer, running match of spliced veneer leaves assembled on door or panel face; unless otherwise indicated.
 1. Vertical Edges: Any option allowed by quality standard for grade.
 2. "Running Match" each pair of doors and doors in close proximity to each other.
 3. "Pair Match" each pair of doors; "Set Match" pairs of doors within 10 feet of each other when doors are closed.
- B. Facing Adhesive: Type II - water resistant.

2.06 DOOR CONSTRUCTION

- A. Fabricate doors in accordance with door quality standard specified.
- B. Cores Constructed with stiles and rails:
 1. Provide solid blocks at lock edge and top of door for closer for hardware reinforcement.

- C. Glazed Openings: Non-removable stops on non-secure side; sizes and configurations as indicated on drawings.
- D. Factory machine doors for hardware other than surface-mounted hardware, in accordance with hardware requirements and dimensions.
- E. Factory fit doors for frame opening dimensions identified on shop drawings, with edge clearances in accordance with specified quality standard.
- F. Provide edge clearances in accordance with the quality standard specified.

2.07 FINISHES - WOOD VENEER DOORS

- A. Finish work in accordance with AWMAC/WI (NAAWS), Section 5 - Finishing for grade specified and as follows:
 - 1. Transparent:
 - a. System - 11 Polyurethane Catalyzed.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.
 - 2. Opaque:
 - a. System - 4 Latex Acrylic Water-based.
 - b. Color: As selected by Architect.
 - c. Sheen: Flat.
- B. Finish work in accordance with WDMA I.S. 1A for grade specified and as follows:
 - 1. Transparent:
 - a. System - TR-6, Catalyzed Polyurethane.
 - b. Stain: As selected by Architect.
 - c. Sheen: Satin.
 - 2. Opaque:
 - a. Manufacturers standard, in compliance with performance duty level indicated.
 - b. Color: As selected by Architect.
 - c. Sheen: Satin.
- C. Factory finish doors in accordance with approved sample.
- D. Seal door top edge with color sealer to match door facing.

2.08 ACCESSORIES

- A. Hollow Metal Door Frames: See Section 08 11 13.
- B. Glazed Openings: Comply with CBC Section 716.2.5 and Chapter 24.
 - 1. Vision Panel: Factory installed.
 - a. Application: Provide at all new classroom, office, corridor and other teacher and staff occupied spaces.
 - b. Size (WxH): 6 by 32 inches, unless indicated otherwise on Drawings.
 - 2. Glazing: Single vision units, 1/4 inch thick glass.
 - 3. Tint: Clear.
- C. Glazing Stops: Wood, of same species as door facing, butted corners; prepared for countersink style tamper proof screws.

- D. Door Hardware: See Section 08 71 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Do not install doors in frame openings that are not plumb or are out-of-tolerance for size or alignment.

3.02 INSTALLATION

- A. Install doors in accordance with manufacturer's instructions, rated listing, and specified quality standard.
 - 1. Install fire-rated doors in accordance with NFPA 80 requirements.
 - 2. Install smoke and draft control doors in accordance with NFPA 105 requirements.
- B. Factory-Finished Doors: Do not field cut or trim; if fit or clearance is not correct, replace door.
- C. Use machine tools to cut or drill for hardware.
- D. Coordinate installation of doors with installation of frames and hardware.
- E. Coordinate installation of glazing.

3.03 TOLERANCES

- A. Comply with specified quality standard for fit and clearance tolerances.
- B. Comply with specified quality standard for telegraphing, warp, and squareness.

3.04 ADJUSTING

- A. Adjust doors for smooth and balanced door movement.
- B. Adjust closers for full closure.

3.05 SCHEDULE - SEE DRAWINGS

END OF SECTION

SECTION 08 31 00 ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall- and ceiling-mounted access units.

1.02 RELATED REQUIREMENTS

- A. Section 09 91 23 - Interior Painting: Field paint finish.

1.03 REFERENCE STANDARDS

- A. CBC - California Building Code; Current Adopted Edition.
- B. DSA IR 25-3 - Suspended Gypsum Board Ceiling; Current adopted edition.
- C. ITS (DIR) - Directory of Listed Products; Current Edition.
- D. UL (FRD) - Fire Resistance Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of each access door and/or panel unit.
- D. Manufacturer's Installation Instructions: Indicate installation requirements.
- E. Installer's qualification statement.
- F. Project Record Documents: Record actual locations of each access unit.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
- C. Single-Source Responsibility: Obtain access doors for entire project from one source from a single manufacturer.
- D. Size Variations: Obtain Architect's acceptance of manufacturer's standard size units, which may vary slightly from sizes indicated.
- E. Coordination: Furnish inserts and anchoring devices for building into adjoining Work for installation of access doors.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Fire rated access doors shall conform to California Building Code (CBC) Title 24, Part 2, Chapter 7. Panels shall bear the label of Underwriters Laboratories or other testing agency acceptable to the State Fire Marshal.

- B. Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide access door assembly for rating shown, with flush door, frame, hinge, and latch from manufacturer listed in UL (FRD). Provide UL label on each fire-rated access door.

2.02 ACCESS DOORS AND PANELS ASSEMBLIES

- A. Access Door Materials and Fabrication, General: Provide each access door assembly manufactured as an integral unit, complete with all parts, and ready for installation.
 - 1. If size is not indicated, provide size as directed to adequately access concealed operable mechanisms.
- B. Units in Fire Rated Assemblies: Fire rating equivalent to the fire rated assembly in which they are to be installed.
 - 1. Provide products listed and labeled by UL or ITS (Warnock Hersey) as suitable for the purpose specified and indicated.
- C. Wall-Mounted Units:
 - 1. Location: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size: 12 by 12 inches, nominal minimum..
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
- D. Wall-Mounted Units in Wet Areas:
 - 1. Location: As indicated on drawings.
 - 2. Panel Material: Stainless steel, Type 304.
 - 3. Size: 12 by 12 inches, nominal minimum..
 - 4. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - 5. Wall Mounting Criteria: Provide surface-mounted face frame and door surface flush with frame surface.
- E. Fire-Rated Wall-Mounted Units:
 - 1. Location: As indicated on drawings.
 - 2. Wall Fire-Rating: As indicated on drawings.
 - 3. Panel Material: Steel.
 - 4. Size: 12 by 12 inches, nominal minimum.
 - 5. Door/Panel: Insulated double-surface panel, with tool-operated spring or cam lock and no handle.
- F. Ceiling-Mounted Units:
 - 1. Location: As indicated on drawings.
 - 2. Panel Material: Steel.
 - 3. Size - Lay-In Grid Ceilings: To match module of ceiling grid.
 - 4. Size - Other Ceilings: 12 by 12 inches.
 - a. Maximum 325 square inches per DSA IR 25-3 in suspended gypsum board ceilings, for utility access only.
 - 1) Provide a permanently attached warning label stating:

- (a) "Warning: Do not climb, walk, or crawl on the gypsum board ceiling panels or metal framing. Do not store or stow anything on the gypsum board or metal framing."
- 5. Door/Panel: Hinged, standard duty, with tool-operated spring or cam lock and no handle.
 - a. Open with allen wrench - no keys.
 - b. Include a retention spring or bar to keep door from falling open rapidly.

2.03 WALL- AND CEILING-MOUNTED ACCESS UNITS

A. Manufacturers:

- 1. Activar Construction Products Group, Inc. - JL Industries: www.activarcpg.com/#sle.
- 2. ACUDOR Products Inc: www.acudor.com/#sle.
- 3. Babcock-Davis: www.babcockdavis.com/#sle.
- 4. Cendrex, Inc: www.cendrex.com/#sle.
- 5. Karp Associates, Inc: www.karpinc.com/#sle.
- 6. Larsen's Manufacturing Co.: www.larsensmfg.com.
- 7. Nystrom, Inc: www.nystrom.com/#sle.
- 8. Substitutions: See Section 01 60 00 - Product Requirements.

B. Wall- and Ceiling-Mounted Units: Factory-fabricated door and frame, fully assembled units with corner joints welded, filled and ground flush; square and without rack or warp; coordinate requirements with type of installation assembly being used for each unit.

- 1. Style: Exposed frame with door surface flush with frame surface.
 - a. Gypsum Board Mounting Criteria: Use drywall bead type frame.
 - b. Plaster Mounting Criteria: Use plaster bead type frame.
- 2. Door Style: Single thickness with rolled or turned in edges.
- 3. Frames: 16-gauge, 0.0598-inch minimum thickness.
- 4. Heavy-Duty Frames: 14-gauge, 0.0747-inch minimum thickness.
- 5. Single Steel Sheet Door Panels: 16-gauge, 0.0625-inch minimum thickness.
- 6. Door Panels to Receive Wall/Ceiling Finish: Surface recessed 5/8 inch back from wall face.
 - a. For recess-mounted access doors, provide access sleeves for each locking device.
 - b. Provide plastic grommets for installation in holes cut through finish.
 - c. Provide recess-mounted doors for concealed installation in:
 - 1) Acoustic tile ceiling systems, where indicated.
 - 2) Acoustical tile-finished gypsum board ceilings, where indicated.
 - 3) Gypsum board walls, where indicated.
 - 4) Ceramic tile walls, where indicated.
- 7. Insulation: Non-combustible mineral wool or glass fiber.
- 8. Units in Fire-Rated Assemblies: Fire rating as required by applicable code for fire-rated assembly that access doors are being installed.
 - a. Provide products listed by ITS (DIR) or UL (FRD) as suitable for purpose indicated.
 - b. Provide certificate of compliance from authorities having jurisdiction indicating approval of fire rated doors.

9. Primed and Factory Finish: Polyester powder coat; color as selected by Architect from manufacturer's standard colors.
10. Door/Panel Size: As indicated on the drawings.
11. Hardware:
 - a. Hardware for Fire-Rated Units: As required for listing.
 - b. Hinges for Non-Fire-Rated Units: Concealed, constant force closure spring type.
 - c. Latch/Lock: Screw driver slot for quarter turn cam latch.
 - d. Gasketing: Extruded neoprene, around perimeter of door panel.
- C. Provide recess-mounted doors and frames with expanded metal lath for concealed installation in plaster.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings are correctly sized and located.
- B. Begin installation only after substrates have been properly prepared, and if the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to proceeding with this work.
- B. Prepare surfaces using methods recommended by manufacturer for applicable substrates in accordance with project conditions.

3.03 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings, and secure units rigidly in place.
- C. Provide for correct termination of adjoining finish materials.
- D. Position units to provide convenient access to concealed equipment when necessary.

3.04 ADJUST AND CLEAN

- A. Adjust access doors and hardware after installation for proper and smooth operation.
- B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.
- C. Remove protective coverings and clean stainless steel access doors during cleaning for Substantial Completion Review.

3.05 SCHEDULES

- A. Access Door Locations:
 1. Provide access doors where indicated on Architectural, Mechanical, Plumbing and Electrical Drawings.
 2. Access doors indicated and required for Mechanical, Plumbing and Electrical Work shall be of a type matching those specified in this Section.
 3. Provide access doors as required to service building systems and as required by governing authorities, although not shown on Drawings.
 - a. Provide at smoke or fire detector in attic spaces. Size to allow for access and testing.

4. Locate access doors, where practical, in building service areas and not in public or guest view.
 5. Submit proposed locations for access doors, not indicated on Drawings, to Architect for review prior to rough-in.
- B. Non-Fire Rated Door and Frame Units in Walls:
1. In Gypsum Board on Studs:
 - a. For service and utility locations, primer paint finish, Model DSC-214M manufactured by Karp.
 - b. For food service, toilet and damp locations, stainless steel, Model DSC-214M manufactured by Karp.
 - c. For Administration, Multi-Purpose and similar areas accessible by general public, recessed face for field-applied and finished plaster on door face, Model RDW manufactured by Karp.
 - d. For toilets and locations accessible by general public with ceramic tile wall finish, flush-mounted with face of tile, stainless steel, Model DSB-214M manufactured by Karp.
- C. Non-Fire Rated Door and Frame Units in Ceilings:
1. In Gypsum Board on Metal Furring:
 - a. For service and utility locations, primer paint finish, Model DSC-214M manufactured by Karp.
 - b. For food service, toilet and damp locations, stainless steel, Model DSC-214M manufactured by Karp.
 - c. For Administration, Multi-Purpose and similar areas accessible by general public, recessed face for field-applied and finished plaster on door face, Model RDW manufactured by Karp.
- D. Fire-Rated Access Doors: Access doors in time-rated fire-resistive walls, partitions and ceilings shall carry same rating as the wall, partition or ceiling.
- E. Fire Rated Door and Frame Units in Walls:
1. In Gypsum Board on Studs:
 - a. 1-1/2 hour B label fire rating.
 - b. For public areas, service and utility locations, primer paint finish, surface mounted, filled with 2-inch thick fire-rated insulation, with automatic closer, self-latching bolt-type latch, Model KPR-150FR manufactured by Karp.
 - c. For Food Service, Toilet and other damp locations with ceramic tile finish, stainless steel finish, surface mounted, filled with 2-inch thick fire-rated insulation, with automatic closer, self-latching bolt-type latch, Model KPR-150FR manufactured by Karp.
- F. Fire Rated Door and Frame Units in Ceilings:
1. In Gypsum Board on Metal Furring:
 - a. For typical dry locations, surface mounted, primer paint finish, filled with 2-inch thick fire-rated insulation, with automatic closer, self-latching bolt-type latch, Model KRP-150FR manufactured by Karp.

- b. For Food Service, Toilet and other damp locations, stainless steel finish, surface mounted, filled with 2-inch thick fire-rated insulation, with automatic closer, self-latching bolt-type latch, Model KPR-150FR manufactured by Karp.

END OF SECTION

SECTION 08 43 13 ALUMINUM-FRAMED STOREFRONTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass.
- B. Infill panels of glass.
- C. Aluminum doors and frames.
- D. Weatherstripping.
 - 1. Perimeter sealant.

1.02 RELATED REQUIREMENTS

- A. Section 05 12 00 - Structural Steel Framing: Steel attachment members.
- B. Section 05 50 00 - Metal Fabrications: Steel attachment devices.
- C. Section 06 10 00 - Rough Carpentry: Attachment to wood.
- D. Section 07 25 00 - Weather Barriers: Sealing framing to water-resistive barrier installed on adjacent construction.
- E. Section 07 92 00 - Joint Sealants: Sealing joints between frames and adjacent construction.
- F. Section 08 71 00 - Door Hardware: Hardware items other than specified in this section.
- G. Section 08 80 00 - Glazing: Glass and glazing accessories.

1.03 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site; 2015.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. AAMA 501.2 - Quality Assurance and Diagnostic Water Leakage Field Check of Installed Storefronts, Curtain Walls, and Sloped Glazing Systems; 2015.
- D. AAMA 503 - Voluntary Specification for Field Testing of Newly Installed Storefronts, Curtain Walls and Sloped Glazing Systems; 2014.
- E. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); 2015.
- F. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; 2020.
- G. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; 2009.
- H. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- I. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- J. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2021a.
- K. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- L. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.

- M. ASTM D2000 - Standard Classification System for Rubber Products in Automotive Applications; 2018.
- N. ASTM D2287 - Standard Specification for Nonrigid Vinyl Chloride Polymer and Copolymer Molding and Extrusion Compounds; 2012.
- O. ASTM E283/E283M - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Skylights, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2019.
- P. ASTM E330/E330M - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014 (Reapproved 2021).
- Q. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2023).
- R. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2015 (Reapproved 2023).
- S. CBC - California Building Code; Current Adopted Edition.
- T. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.
- U. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Structural and Energy design of the system has already been used as a basis of approval by Division of the State Architect and other agencies. If a substitution is proposed, then the Contractor is responsible for the re-approval of the documents in a timely manner within the original project schedule, along with all professional and agency fees related to this substitution. See Section 01 60 00 - Product Requirements.
- C. Product Data: Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, door hardware, and internal drainage details.
- D. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related work, expansion and contraction joint location and details, and field welding required.
 - 1. Include construction details and fabrication methods, profiles and dimensions of individual components, data on hardware, accessories, and finishes.
 - 2. Complete, indicating elevation views of all units, attachments to surrounding construction of Project, type of glazing, and all door hardware and weatherstripping. Manufacturer to prepare all Shop Drawings and include manufacturer's logo.
- E. Samples: Submit two samples 2 x 3 inches in size illustrating finished aluminum surface, glass, infill panels, glazing materials.
- F. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
 - 1. Energy Model Submissions:

- a. Provide a copy of the project ENV-1 form.
 - b. Provide evidence that the proposed products can meet or exceed the energy values listed on the ENV-1 form. Preferred method is an NFRC site certificate, but a simulation report by an independent NFRC certified simulator will be considered. *AAMA test reports and or simulations will not be accepted as they are not allowed under the current code.*
 - c. Provide a statement of who will be the “responsible party” in issuing the NFRC site certificates.
- G. Hardware Schedule: Complete itemization of each item of hardware to be provided for each door, cross-referenced to door identification numbers in Contract Documents.
- H. Field Quality Control Submittals: Report of field testing for water penetration and air leakage.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.
- K. Specimen warranty.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in performing work of type specified and with at least ten years of documented experience.
- 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- B. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.
- C. Single-Source Responsibility: All entrances and storefront framing and doors, including finish, shall be the product of one manufacturer.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Construct in-place mock-up, 8 feet long by 8 feet wide, indicating finishes, application methods, and weathertight construction feet.
- C. Locate where directed.
- D. Mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.
- 1. Store storefront sections out of contact with the ground and under a weather tight covering. Do not cover storefront sections with polyethylene film or similar coverings that will create a humidity chamber.
 - 2. Protect surfaces during shipping and handling to prevent scratching, gouging or other damage to the finish.

1.09 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F. Maintain this minimum temperature during and 48 hours after installation.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.
- E. Provide two year manufacturer warranty against failure of door corner construction for standard duty narrow or medium stile doors.
- F. Provide five year manufacturer warranty against failure of door corner construction for heavy duty wide stile doors.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with Code requirements for safety glazing, accessibility and exit devices.
 - 1. Conform to applicable requirements of the ADA Standards regarding accessibility requirements for door and entrance hardware.
 - 2. Exit Doors: Openable at all times from the inside without the use of a key or any special knowledge or effort.
 - 3. Exit devices shall comply with CBC Section 1010.1.9.1 and 11B-404.2.7. Lever handle trim to match locksets.
 - 4. Conform to applicable requirements of Title 24, Part 2, CCR, including CBC Chapter 11B-404.2.7, 11B-404.2.9, and 1010.1.9, regarding exiting and accessibility requirements for door and entrance hardware.
 - 5. Exterior doors to have 5 pounds maximum pressure to open and interior doors to have 5 pounds maximum pressure to open. CBC Chapter 11B-404.2.9.

2.02 MANUFACTURERS

- A. Aluminum-Framed Storefronts:
 - 1. Basis of Design: Kawneer North America; Trifab VersaGlaze 451/451T Framing System Center Plane (Center Plane - Screw Spline): www.kawneer.com/#sle.
 - 2. Basis of Design: Oldcastle BuildingEnvelope; Series 3000 Thermal Multiplane (Center Set): www.oldcastlebe.com/#sle.
 - 3. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ALUMINUM-FRAMED STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch insulating glazing.
 - 2. Glazing Position: Centered (front to back).

3. Finish: Class I color anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 4. Finish Color: As selected by Architect from manufacturer's standard line.
 5. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 6. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 7. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 8. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170 degrees F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 9. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 10. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 11. Maintain continuous air barrier and/or vapor retarder seal throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel, and heel bead of glazing compound.
 12. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Performance Requirements
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of ASCE 7.
 - b. Member Deflection: Limit member deflection to flexure limit of glass or 1/175 of span, maximum 3/4 inch (over 11'-0" span), in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance on Manufactured Assembly: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8 psf.
 3. Air Leakage: 0.06 cfm/sq ft maximum leakage of storefront wall area when tested in accordance with ASTM E283/E283M at 1.57 psf pressure difference.
 4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
 5. Resistance to Forcible Entry: Jambs adjacent to door locks shall resist a force of 1600 lbs

2.04 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.
1. Framing members for interior applications need not be thermally broken.

2. Glazing Stops: Flush.
 3. Cross-Section: As indicated on drawings.
 4. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: See Section 08 80 00.
- C. Swing Doors: Glazed aluminum.
1. Thickness: 1-3/4 inches.
 2. Top Rail: 6 inches wide, nominal.
 3. Vertical Stiles: 5 inches wide, nominal. Coordinate with hardware for a complete installation.
 4. Bottom Rail: 10 inches wide.
 5. Glazing Stops: Square.
 6. Finish: Same as storefront.

2.05 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M).
- B. Sheet Aluminum: ASTM B209/B209M.
- C. Structural Steel Sections: ASTM A36/A36M; shop primed.
- D. Fasteners: Stainless steel.
- E. Exposed Flashings: Aluminum sheet, 20 gauge, 0.032 inch minimum thickness; finish to match framing members.
- F. Concealed Flashings: Galvanized steel, 26 gauge, 0.0179 inch minimum base metal thickness.
- G. Perimeter Sealant: As specified in Section 07 92 00 - Joint Sealants.
- H. Sill Flashing Sealant: Elastomeric, silicone or polyurethane, compatible with flashing material.
- I. Sealant for Setting Thresholds: Non-curing butyl type.
- J. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- K. Glazing Accessories: See Section 08 80 00.
- L. Shop and Touch-Up Primer for Steel Components: Zinc oxide, alkyd, linseed oil primer appropriate for use over hand cleaned steel.
- M. Touch-Up Primer for Galvanized Steel Surfaces: SSPC-Paint 20, zinc rich.

2.06 FINISHES

- A. Class I Color Anodized Finish: AAMA 611 AA-M12C22A42 Integrally colored anodic coating not less than 0.7 mils thick.
- B. Color: As selected by Architect from manufacturer's custom range.
- C. Touch-Up Materials: As recommended by coating manufacturer for field application.

2.07 HARDWARE

- A. For each door, include weatherstripping, sill sweep strip, and threshold.
- B. Other Door Hardware: See Section 08 71 00.

- C. Weatherstripping: Manufacturer's standard replaceable compressible weatherstripping gaskets of molded neoprene complying with ASTM D2000 or molded PVC complying with ASTM D2287 pile, continuous and replaceable; provide on all exterior doors.
- D. Sill Sweep Strips: Resilient seal type, retracting, of neoprene; provide on all doors.
- E. Threshold: Extruded aluminum, one piece per door opening, ribbed surface; provide on all doors.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that storefront wall openings and adjoining water-resistive and/or air barrier seal materials are ready to receive work of this section.

3.02 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
 - 1. Anchoring: Firmly anchor framing using fasteners as recommended by manufacturer, sized to suit loads and type suitable for substrate, to positively attach members for long life under hard use.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
 - 1. Comply with requirements specified in Section 07 62 00 - Sheet Metal Flashing and Trim. Set sill flashing in bedding sealant as specified in Section 07 92 00 - Joint Sealants.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Install perimeter sealant in accordance with Section 07 92 00-Joint Sealants.
- J. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- K. Door Installation: Assemble doors in shop with glazing installed.
 - 1. Door Joints: Make joints rigid and suitable for heavy use.
- L. Set thresholds in bed of sealant and secure.
- M. Install glass using glazing method required to achieve performance criteria; see Section 08 80 00.
- N. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.03 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inch per 3 feet non-cumulative or 0.06 inch per 10 feet, whichever is less.

- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.04 FIELD QUALITY CONTROL

- A. Provide services of storefront manufacturer's field representative to observe for proper installation of system and submit report.
- B. See Section 01 40 00 - Quality Requirements for independent field testing and inspection requirements, and requirements for monitoring quality of specified product installations.
- C. Water-Spray Test by Contractor: Provide water spray quality test of installed storefront components in accordance with AAMA 501.2 during construction process and before installation of interior finishes.
1. Perform a minimum of two tests in each designated area as directed by Architect.
 2. Conduct tests in each area prior to 10 percent and 50 percent completion of this work.
 3. Testing: Installer to water test all storefront and glazing in the presence of the Architect, Project Inspector (IOR), and Construction Manager by spraying with hose heavily for 5 minutes. Repair all leaks discovered by testing procedures and repeat test until leak-free performance is achieved.
- D. District to Provide field testing of installed storefront system by AAMA accredited independent laboratory in accordance with AAMA 503 during construction process and before installation of interior finishes.
1. Perform a minimum of two tests in each designated area as indicated on drawings.
 2. Conduct tests in each area prior to 35 percent and 70 percent completion of this work.
 3. Field test for water penetration in accordance with ASTM E1105 with uniform static air pressure difference (Procedure A) not less than 4.18 psf.
 - a. Maximum allowable rate of water penetration in 15-minute test is 0.5 ounce that is not contained in an area with provisions to drain to exterior, or collected on surface of interior horizontal framing member.
- E. Repair or replace storefront components that have failed designated field testing, and retest to verify performance complies with specified requirements.

3.05 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.06 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths, and take care to remove dirt from corners and to wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.

3.07 PROTECTION

- A. Protect installed products from damage until Date of Substantial Completion.

END OF SECTION

SECTION 08 71 00 DOOR HARDWARE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Hardware for hollow metal doors.
- B. Lock cylinders for doors that hardware is specified in other sections.
- C. Thresholds.
- D. Weatherstripping and gasketing.
- E. Gate hardware as noted.
- F. Specific Omissions: Hardware for the following is specified or indicated elsewhere.
 - 1. Windows.
 - 2. Welded steel gates and supports. (Except as scheduled)

1.02 RELATED REQUIREMENTS

- A. Section 06 41 00 - Architectural Wood Casework: Cabinet hardware.
- B. Section 07 92 00 - Joint Sealants: Sealants for setting exterior door thresholds.
- C. Section 08 06 71 - Door Hardware Schedule: Schedule of door hardware sets.
- D. Section 08 11 13 - Hollow Metal Doors and Frames.
- E. Section 08 14 16 - Flush Wood Doors.
- F. Section 08 43 13 - Aluminum-Framed Storefronts: Door hardware, except as noted in section.
- G. Section 10 14 23 - Panel Signage: Additional signage requirements.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. BHMA (CPD) - Certified Products Directory; Current Edition.
- C. BHMA A156.1 - Standard for Butts and Hinges; 2021.
- D. BHMA A156.3 - Exit Devices; 2020.
- E. BHMA A156.4 - Door Controls - Closers; 2019.
- F. BHMA A156.5 - Cylinders and Input Devices for Locks; 2020.
- G. BHMA A156.6 - Standard for Architectural Door Trim; 2021.
- H. BHMA A156.7 - Template Hinge Dimensions; 2016.
- I. BHMA A156.8 - Door Controls - Overhead Stops and Holders; 2021.
- J. BHMA A156.13 - Mortise Locks & Latches Series 1000; 2022.
- K. BHMA A156.14 - Standard for Sliding and Folding Door Hardware; 2019.
- L. BHMA A156.16 - Standard for Auxiliary Hardware; 2023.
- M. BHMA A156.17 - Self Closing Hinges & Pivots; 2019.
- N. BHMA A156.20 - Standard for Strap and Tee Hinges, and Hasps; 2021.
- O. BHMA A156.21 - Thresholds; 2019.

- P. BHMA A156.22 - Standard for Gasketing; 2021.
- Q. BHMA A156.26 - Standard for Continuous Hinges; 2021.
- R. BHMA A156.28 - Standard for Recommended Practices for Mechanical Keying Systems; 2023.
- S. BHMA A156.36 - Auxiliary Locks; 2020.
- T. BHMA A156.115 - Hardware Preparation in Steel Doors and Frames; 2016.
- U. BHMA A156.115W - Hardware Preparation in Wood Doors with Wood or Steel Frames; 2006.
- V. CBC - California Building Code; Current Adopted Edition.
- W. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- X. DHI (H&S) - Sequence and Format for the Hardware Schedule; 2019.
- Y. DHI (KSN) - Keying Systems and Nomenclature; 2019.
- Z. DHI (LOCS) - Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames; 2004.
- AA. DHI WDHS.3 - Recommended Locations for Architectural Hardware for Flush Wood Doors; 1993; also in WDHS-1/WDHS-5 Series, 1996.
- BB. DSA BU 11-05 - Impact of AB 211 - Concerning Door Hardware; Current adopted edition.
- CC. DSA BU 19-05 - AB 3205 Door Hardware Requirements; Current adopted edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the manufacture, fabrication, and installation of products that door hardware is installed on.
- B. Sequence installation to ensure utility connections are achieved in an orderly and expeditious manner.
- C. Preinstallation Meeting: Convene a preinstallation meeting one week prior to commencing work of this section; attendance is required by affected installers and the following:
 - 1. Architect.
 - 2. Installer's Architectural Hardware Consultant (AHC).
 - 3. Hardware Installer.
 - 4. Owner's Security Consultant.
- D. Furnish templates for door and frame preparation to manufacturers and fabricators of products requiring internal reinforcement for door hardware.
- E. Keying Requirements Meeting:
 - 1. Schedule meeting at project site prior to Contractor occupancy.
 - 2. Attendance Required:
 - a. Contractor.
 - b. District and relevant staff.
 - c. Architect.
 - d. Installer's Architectural Hardware Consultant (AHC).
 - e. Hardware Installer.
 - f. Owner's Security Consultant.
 - 3. Agenda:
 - a. Establish keying requirements.

- b. Verify locksets and locking hardware are functionally correct for project requirements.
 - c. Verify that keying and programming complies with project requirements.
 - d. Establish keying submittal schedule and update requirements.
4. Contractor to provide a blank key schedule in excel format for District review and approval prior to formal submittal.
5. Incorporate "Keying Requirements Meeting" decisions into keying submittal upon review of door hardware keying system including, but not limited to, the following:
 - a. Access control requirements.
 - b. Key control system requirements.
 - c. Schematic diagram of preliminary key system.
6. Record minutes and distribute copies within two days after meeting to participants, with two copies to Architect, District, participants, and those affected by decisions made.
 - a. Furnish District's written approval of the system; do not order keys or cylinders without written confirmation of actual requirements from the District.
7. Deliver established keying requirements to manufacturers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work
- C. Product Data: Manufacturer's catalog literature for each type of hardware, marked to clearly show products to be furnished for this project, and includes construction details, material descriptions, finishes, and dimensions and profiles of individual components.
- D. Shop Drawings - Door Hardware Schedule: Submit detailed listing that includes each item of hardware to be installed on each door. Use door numbering scheme as included in Contract Documents.
 1. Prepared by or under supervision of Architectural Hardware Consultant (AHC).
 2. Comply with DHI (H&S) using door numbers and hardware set numbers as indicated in construction documents.
 - a. Submit in vertical format; see Section 08 0671.
 3. List groups and suffixes in proper sequence.
 4. Provide complete description for each door listed.
 5. Provide manufacturer name, product names, and catalog numbers; include functions, types, styles, sizes and finishes of each item.
 6. Include account of abbreviations and symbols used in schedule.
- E. Samples for Verification:
 1. Submit minimum size of 2 by 4 inch for sheet samples, and minimum length of 4 inch for other products.
 2. Submit one (1) sample of hinge, latchset, lockset, and closer illustrating style, color, and finish.
 3. Return full-size samples to be incorporated into this Work.
 4. Submit product description with samples.

- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Maintenance Data: Include data on operating hardware, lubrication requirements, and inspection procedures related to preventative maintenance.
 - 1. Submit manufacturer's parts lists and templates.
 - 2. Bitting List: List of combinations as furnished.
- H. Keying Schedule:
 - 1. Submit three (3) copies of Keying Schedule in compliance with requirements established during Keying Requirements Meeting unless otherwise indicated.
- I. Manufacturer's qualification statement.
- J. Installer's qualification statement.
- K. Supplier's qualification statement.
- L. District Responsibilities for submittal review:
 - 1. Complete keying schedule.
 - 2. Complete keying legend.
 - 3. Provide original letter of authorization allowing hardware supplier to purchase keying hardware and to have the bitting list sent to District.
 - 4. Provide District the locksmith's name, address, phone number and email.
 - 5. Identify how doors are to be keyed.
 - 6. For existing systems, provide the registry number.
- M. Project Record Documents: Record actual locations of concealed equipment, services, and conduit.
 - 1. Include keying schedule, riser and point-to-point wiring diagrams, manufacturers' installation, adjustment and maintenance information, and supplier's final inspection report
- N. Maintenance Materials and Tools: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Lock Cylinders: Ten for each master keyed group.
 - 3. Temporary Cores: Return to and receipt by Contractor.
 - 4. Tools: Two sets of each special wrench or tool applicable for each different or special hardware component, whether supplied by hardware component manufacturer or not.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified for commercial door hardware with at least three years of documented experience.
- C. Supplier Qualifications: Company with certified Architectural Hardware Consultant (AHC) to assist in work of this section.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Package hardware items individually; label and identify each package with door opening code to match door hardware schedule.

1.08 PROJECT CONDITIONS AND COORDINATION:

- A. Where exact types of hardware specified are not adaptable to finished shape or size of members requiring hardware, provide suitable types having as nearly as practical the same operation and quality as type specified, subject to Architect's approval.
- B. Coordination:
 - 1. Coordinate hardware with other work.
 - 2. Provide hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.
 - 3. Furnish related trades with the following information:
 - a. Location of embedded and attached items to concrete.
 - b. Location of wall-mounted hardware, including wall stops.
 - c. Location of finish floor materials and floor-mounted hardware.
 - d. Coordinate: flush top rails of doors at outswinging exteriors, and throughout where adhesive-mounted seals occur.
 - e. Manufacturers' templates to door and frame fabricators.
- C. Check Shop Drawings for doors and entrances to confirm that adequate provisions will be made for proper hardware installation.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer's Warranty: Provide warranty against defects in material and workmanship for period indicated. Complete forms in District's name and register with manufacturer.
 - 1. Mechanical Closers: Thirty years, minimum.
 - 2. Mechanical Exit Devices: Three years, minimum.
 - 3. Mechanical Locksets and Cylinders: Three years, minimum.
 - 4. Continuous and Butt Hinges: Life of the building.
 - 5. Key Blanks: Lifetime
 - 6. Other Hardware: Two years, minimum.
- C. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

PART 2 PRODUCTS

2.01 DESIGN AND PERFORMANCE CRITERIA

- A. Provide specified door hardware as required to make doors fully functional, compliant with applicable codes, and secure to extent indicated.
- B. Provide individual items of single type, of same model, and by same manufacturer.
- C. Regulatory Requirements:
 - 1. Comply with State Fire Marshal Standards.

- a. Lever of lever actuated latches or locks shall be curved with a return to within 1/2 inch of the door to prevent catching on the clothing of persons during egress. SFM 12-10-2 Latching/Locking, Section 12-10-202(f).
 - b. The cross-bar shall extend across not less than one-half the width of the door/gate. 12-10-3 Exits, Section 12-10-302(a).
 - c. The ends of the cross-bar shall be curved, guarded or otherwise designed to prevent catching on the clothing of persons during egress. SFM 12-10-3 Exits, Section 12-10-302(d).
2. Conform to applicable requirements of the CBC Chapter 11B and ADA Standards regarding accessibility requirements for door and entrance hardware including gates.
 - a. Doors/doorways as part of an accessible route shall comply with CBC Sections 11B-404.
 - b. Doors shall meet California Building Code Sections 11B-206.5, 11b-404.1 and 1010.1.
 - c. The clear opening width for a door shall be 32 inches minimum. CBC Section 11B-404.2.3
 - 1) For a swinging door it shall be measured between the face of the door and the stop, with the door open 90 degrees.
 - 2) There shall be no projections into it below 34 inches and 4 inches maximum projections into it between 34 inches and 80 inches above the finish floor or ground.
 - 3) Door closers and stops shall be permitted to be 78 inches minimum above the finish floor or ground.
 - 4) Exception: Doors not requiring full passage through the opening, that is, to spaces less than 24 inches in depth, may have the clear opening width reduced to 20 inches. Example: shallow closets.
 - d. Handles, pulls, latches, locks, and other operable parts on accessible doors shall comply with CBC Section 11B-309.4 and shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist.
 - 1) Operable parts of such hardware shall be 34 inches minimum and 44 inches maximum above finish floor or ground.
 - 2) Where sliding doors are in the fully open position, operating hardware shall be exposed and usable from both side. CBC Section 11B-404.2.7
 - e. The force for pushing or pulling open a door shall be as follows : CBC Section 11B-404.2.9.
 - 1) Interior Hinged Doors, sliding or folding doors, and exterior hinged doors: 5 lbs maximum.
 - 2) Required Fire Doors: the minimum opening force allowable by the DSA authority, not to exceed 15 lbs..
 - 3) These forces do not apply to the force required to retract latch bolts or disengage other devices that hold the door in a closed position.
 - 4) The force required to activate any operable parts, such as retracting latch bolts or disengaging other devices, shall be 5 lbs. maximum to comply with CBC Section 11B-309.4.
 - f. Door closing speed shall be as follows: CBC Section 11B-404.2.8

- 1) Closer shall be adjusted so that the required time to move a door from an open position of 90 degrees to a position of 12 degrees from the latch is 5 seconds minimum.
 - 2) Spring hinges shall be adjusted so that the required time to move a door from an open position of 70 degrees to the closed position is 1.5 seconds minimum.
 - g. Thresholds shall comply with CBC Section 11B-404.2.5.
 - h. Floor stops shall not be located in the path of travel and 4 inches maximum from walls.
 - i. Hardware (including exit devices) shall not be provided with "Night Latch" (NL) function for any accessible doors or gates unless the following conditions are met.
 - 1) Such hardware has a 'dogging' feature.
 - 2) It is dogged during the time the facility is open.
 - 3) Such 'dogging' operation is performed only by employees as their job function (non-public use).
 - j. Pair of doors: Limit swing of one leaf to 90 degrees so that a clear floor space is provided beyond the arc of the swing for the wall-mounted tactile sign. CBC Section 11B-703.4.2.1
 3. Door and door hardware encroachment: when door is swung fully-open into means-of-egress path, the door, including the hardware, may not encroach or project more than 7 inches into the required exit width. California Building Code 1005.7.1.
 4. Education Code (EDC) Section 17583 (SB/AB 211 & AB 3205) - DSA Bulletins, DSA BU 11-05 and DSA BU 19-05.
 - a. Provide all latching devices that are lockable (including but not limited to door locks and panic/exit devices) that comply with CBC 1010.2.8.2:
 - 1) All new construction projects to include locks that allow the doors to be locked from the inside.
 - 2) The requirement applies to classrooms and any other room with an occupancy of 5 or more persons, but does not include doors that are locked from the outside at all times or student restrooms.
- D. Provide door hardware products that comply with the following requirements:
1. Applicable provisions of federal, state, and local codes.
 2. Comply with DSA BU 11-05 and DSA BU 19-05; CBC section 1010.2.8..2
 3. Accessibility: ADA Standards, CBC Chapter 11B.
 4. Listed and certified compliant with specified standards by BHMA (CPD).
 5. Auxiliary Hardware: BHMA A156.16.
 6. Straps and Tee Hinges: BHMA A156.20.
 7. Hardware Preparation for Steel Doors and Steel Frames: BHMA A156.115.
 8. Hardware Preparation for Wood Doors with Wood or Steel Frames: BHMA A156.115W.
- E. Lock Function: Provide lock and latch function numbers and descriptions of manufacturer's series. See Door Hardware Schedule.
1. Exit Doors: Openable at all times from the inside without the use of a key or any special knowledge or effort.
- F. Fasteners:

1. Provide fasteners of proper type, size, quantity, and finish that comply with commercially recognized standards for proposed applications.
 - a. Aluminum fasteners are not permitted.
 - b. Provide phillips flat-head screws with heads finished to match door surface hardware unless otherwise indicated.
2. Provide machine screws for attachment to reinforced hollow metal and aluminum frames.
 - a. Self-drilling (Tek) type screws are not permitted.
3. Provide stainless steel machine screws and lead expansion shields for concrete and masonry substrates.
4. Coordinate With Doors: Ensure provision of proper blocking to support wood screws at wood doors and machine screws at metal doors/frames to mounting panic hardware and door closers.
5. No through-bolts are allowed on any door type.
6. Concealed Fasteners: Do not use through or sex bolt type fasteners on door panel sides indicated as concealed fastener locations, unless otherwise indicated.

2.02 HINGES

- A. Butt Hinge Manufacturers:
 1. Substitutions: Not permitted.
- B. Continuous Hinge Manufacturers:
 1. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Hinges: Comply with BHMA A156.1, Grade 1.
 1. Self Closing Hinges: Comply with BHMA A156.17.
 2. Butt Hinges: Comply with BHMA A156.1 and BHMA A156.7 for templated hinges.
 - a. Provide hinge width required to clear surrounding trim.
 - b. Drawings typically depict doors at 90 degrees, doors will actually swing to maximum allowable.
 - 1) Use wide-throw conventional or continuous hinges as needed up to 8 inches in width to allow door to stand parallel to wall for true 180-degree opening.
 - 2) Advise Architect if 8 inch width is insufficient.
 - c. Conform to manufacturer's published hinge selection standard for door dimensions, weight and frequency, and to hinge selection as scheduled.
 - 1) Where manufacturer's standard exceeds the scheduled product, furnish the heavier of the two choices, notify Architect of deviation from scheduled hardware.
 - d. Conventional Hinges: Steel or stainless steel pins and concealed bearings. Hinge open widths minimum, but of sufficient throw to permit maximum door swing.
 3. Continuous Hinges: Comply with BHMA A156.26.
 - a. Geared-type aluminum.
 - 1) Use wide-throw units where needed for maximum degree of swing, advise Architect if commonly available hinges are insufficient.
 - 2) If units are used at storefront openings, color-coordinate hinge finish with storefront color.

- (a) Custom anodizing and custom powdercoat finishes subject to Architect approval.
- 4. Provide hinges on every swinging door.
- 5. Provide five-knuckle full mortise butt hinges unless otherwise indicated.
- 6. Provide ball-bearing hinges at each door with closer.
- 7. Provide non-removable pins on exterior outswinging doors.
 - a. Out-swinging exterior doors: Non-ferrous with non-removable (NRP) pins and security studs.
 - b. Non-ferrous material exteriors and at doors subject to corrosive atmospheric conditions.
- 8. Provide non-removable pins on interior outswinging doors at locations as indicated in Door Hardware Schedule.
- 9. Provide following quantity of butt hinges for each door:
 - a. Doors up to 60 inches High: Two hinges.
 - b. Doors From 60 inches High up to 90 inches High: Three hinges.
 - c. Doors 90 inches High up to 120 inches High: Four hinges.

2.03 PIVOTS

- A. Center-Hung and Offset Pivots: Comply with BHMA A156.4.
- B. Self-Closing Pivots: Comply with BHMA A156.17.
- C. High-strength forged bronze or stainless steel, tilt-on precision bearing and bearing pin.
 - 1. Pivot hinges to have oil impregnated bronze bearing in the top pivot and a radial roller and thrust bearing in the bottom pivot with the bottom pivot designed to carry the full weight of the door.
- D. Bottom and intermediate pivots: adjustability of minus 0.063 inch, plus 0.125 inch.
- E. Door Weight: Medium; standard openings with up to 650 lbs door weight.
- F. Space intermediate pivots equally not less than 25 inches on center apart or not more than 35 inches on center for doors over 121 inches high.
- G. Pivots to be UL listed for windstorm where applicable.

2.04 TRACK AND HANGERS

- A. Pocket Doors: Provide pocket door kit, including header assembly, split studs, hangers, door hanger plates, bumper, guides, floor plate, and end bracket.
 - 1. Provide flush cup pull on both sides.
- B. Sliding and Bifolding Door Hardware: Comply with BHMA A156.14.
 - 1. Provide track, hanger fasteners, guides, and pulls; size track and hangers in accordance with manufacturer's recommendations for weight of doors.
 - 2. Provide one pull for each pair of panels hinged together.

2.05 AUTO FLUSH BOLTS

- A. Automatic Flush Bolts: Comply with BHMA A156.16, Grade 1.
 - 1. Flush Bolt Throw: 3/4 inch, minimum.
 - 2. Provides extension bolts in leading edge of door, one bolt into floor, one bolt into top of frame.

- a. Pairs of Swing Doors: At inactive leaves, provide flush bolts of type as required to comply with code.
3. Provide dustproof floor strike for bolt into floor, except at metal thresholds.
4. Manual Flush Bolts: Not permitted.
5. Automatic Flush Bolts: Automatically latch upon closing of door; automatic retraction of bolts when active leaf is opened; located on inactive leaf of pair of doors.

2.06 EXIT DEVICES

- A. Comply with Bulletins DSA BU 11-05 and DSA BU 19-05); CBC Section 1010.2.8.2 and 1010.2.9.
- B. Exit Devices: Comply with BHMA A156.3, Grade 1.
 1. Lever design to match lockset trim.
 - a. Where lever handles are specified as outside trim for exit devices, provide heavy-duty lever trims with forged or cast escutcheon plates. Provide vandal-resistant levers that will travel to 90-degree down position when more than 35 pounds of torque are applied, and which can easily be re-set.
 - 1) Lever Style: Match lever style of locksets.
 - 2) Tactile Warning (Knurling): Where required by authority having jurisdiction. Provide on levers on exterior (secure side) of doors serving rooms considered to be hazardous.
 2. Provide cylinder with cylinder dogging or locking trim on fire non-rated doors.
 3. Provide exit devices properly sized for door width and height.
 4. Provide strike as recommended by manufacturer for application indicated.
 5. Releasable in normal operation with 5-lb. maximum operating force per CBC Ch. 11B-309.4.
 6. Readily openable from egress side with one hand and without tight grasping, tight pinching, or twisting of the wrist to operate.
 7. Comply with CBC Section 1010.2.9 and State Fire Marshal Standard 12-10-3 Exits, Section 12-10-302.
 8. Trim to meet BHMA A156.3 Trim Security Test.
 9. Provide weather-resistant devices when installed on exterior gates.
 10. Independent lab-tested 1,000,000 cycles.
 11. Removable Mullions: 2 inches (51 mm) x 3 inches (76 mm) steel tube. Where scheduled as keyed removable mullion, provide type that can be removed by use of a keyed cylinder, which is self-locking when re-installed. See also Secion 08 11 13 - Hollow Metal Doors and Frames.

2.07 LOCK CYLINDERS

- A. Lock Cylinders: Provide key access on outside of each lock, unless otherwise indicated.
 1. Provide standard, electronic, conventional, and full size interchangeable core (FSIC) type cylinders, Grade 1, with six-pin core in compliance with BHMA A156.5 at locations indicated.
 2. Provide cylinders from same manufacturer as locking device.
 3. Provide cams and/or tailpieces as required for locking devices.

4. Furnish keyed at factory of lock manufacturer where permanent records are maintained.
5. Locks and cylinders by the same manufacturer.
6. Within specific Door Sections, when provisions for lock cylinder are being referenced to this Section, provide specified lock cylinder and keyed to building keying system, unless otherwise indicated.

2.08 MORTISE LOCKS

- A. Comply with Bulletins DSA BU 11-05 and DSA BU 19-05; CBC section 1010.2.8.2.
- B. Mortise Locks: Complying with BHMA A156.13, Grade 1.
 1. Latchbolt Throw: 3/4 inch, minimum.
 2. Deadbolt Throw: 1 inch, minimum.
 3. Backset: 2-3/4 inch unless otherwise indicated.
 4. Strikes: Provide manufacturer's standard strike for each latchset or lockset with strike box and curved lip extending to protect frame in compliance with indicated requirements.
 - a. Flat-Lip Strikes: Provide for locks with three piece antifriction latchbolts as recommended by manufacturer.
 - b. Extra-Long-Lip Strikes: Provide for locks used on frames with applied wood casing trim.
 - c. Aluminum-Frame Strike Box: Provide strike box fabricated for use with aluminum framing by framing manufacturer.
 - d. Rabbet Front and Strike: Provide on locksets for use with rabbeted meeting rails.
 - e. Finish: To match lock or latch.
 5. Lever Trim: through-bolted, accessible design, cast lever or solid extruded bar type levers as scheduled. Filled hollow tube design unacceptable.
 - a. Spindles: security design independent breakaway. Breakage of outside lever does not allow access to inside lever's hubworks to gain wrongful entry.
 - b. Inside lever applied by screwless shank mounting – no exposed trim mount screws.
 - c. Levers rotate up or down for ease of use.
 - d. Solid brass, bronze, or stainless steel, cast or forged in design specified, with wrought roses and external lever spring cages. Provide thru-bolted levers with 2-piece spindles.
- C. Door shall be openable from inside with a single motion w/o the use of any tools, effort, or special knowledge.

2.09 AUXILIARY LOCKS (DEADLOCKS)

- A. Auxiliary Locks (Deadlocks): Comply with BHMA A156.36, Grade 1.
 1. Type: Bored (cylindrical).
 2. Application: Bored.
 3. Backset: 2-3/4 inch, unless otherwise indicated.
 4. Bolt Throw: 1/2 inch, with latch made of hardened steel.
 5. Provide strike that matches frame.

2.10 DOOR PULLS AND PUSH PLATES

- A. Door Pulls and Push Plates: Comply with BHMA A156.6.

1. Pull Type: Straight, unless otherwise indicated.
2. Push Plate Type: Flat, with square corners, unless otherwise indicated.
 - a. Edges: Beveled, unless otherwise indicated.
3. Material: Stainless steel, unless otherwise indicated.
4. Provide door pulls and push plates on doors without a lockset, latchset, exit device, or auxiliary lock unless otherwise indicated.
5. On solid doors, provide matching door pull and push plate on opposite faces.
6. On glazed storefront doors, provide matching door pulls/push plates on both faces unless otherwise indicated.

2.11 COORDINATORS

- A. Coordinators: Provide on doors having closers and self-latching or automatic flush bolts to ensure that inactive door leaf closes before active door leaf.
 1. Type: Bar, unless otherwise indicated.
 2. Material: Aluminum, unless otherwise indicated.
 3. Ensure that coordination of other door hardware affected by placement of coordinators and carry bar is applied properly for completely operable installation.

2.12 CLOSERS

- A. Closers: Comply with BHMA A156.4, Grade 1.
 1. Type: Surface mounted to door.
 2. Provide door closer on each exterior door.
 3. Operating Force: Adjustable to maximum 5 lbs operating force. Comply with ADA Standards and CBC Ch. 11B.
 4. Where an overlapping astragal is included on pairs of swinging doors, provide coordinator to ensure door leaves close in proper order.
 5. At corridor entry doors, mount closer on room side of door.
 6. At outswinging exterior doors, mount closer on interior side of door.

2.13 HYDRAULIC GATE CLOSER AND HINGE

- A. Basis of Design Product: Mammoth 180 with Dino hinge as manufactured by Loconix, or approved equal.
- B. Basis of Design Product: Mammoth HD with Dino hinge as manufactured by Loconix, or approved equal.
- C. Self Closing Hinges: Comply with BHMA A156.17.
- D. Description:
 1. 100% mechanical (no electronic components).
 2. Closing Speed: Adjusting a valve with an Allen key.
 3. Closing Force: Adjustable to maximum 5 lbs operating force. Comply with ADA Standards and CBC Ch. 11B.
 4. Allow for a 180 degrees opening angle of the gate.
 - a. When opened 180 degrees, the gate closer should self-close over the 180 degrees.
 5. Include corresponding bottom hinge.

6. Dampening Mechanism: Hydraulic .
7. The gate closer should be designed and manufactured in Europe or in the United States.
8. The gate closer should have double rubber sealings to avoid oil leakage at all times.
9. Color: Black or silver color, as selected by Architect.

E. Performance

1. The gate closer shall be specifically made for outdoor use (IP69).
2. Gates up to 440 lbs and gate width up to 5 feet.
3. The opening pressure of the gate closer shall be between 3 and 5 lbs. maximum over the full 180 degrees.
4. Guarantee the hydraulic dampening to work properly under all temperature circumstances without any summer or winter adjustments, measured at a 90° opening. The viscosity of the oil shall have no impact on the performance of the gate closer.
 - a. The closing time shall not be below 10 seconds at 70 degrees Celsius (summer).
 - b. The closing time shall not be longer than 30 seconds at -30 degrees Celsius (winter).
5. Tested for 500,000 movements.
6. Maintenance free (no greasing nor oil refill).
7. Manufacturer Warranty: 3 years.

2.14 OVERHEAD STOPS AND HOLDERS

- A. Overhead Stops and Holders (Door Checks): Comply with BHMA A156.8, Grade 1.
1. Provide stop for every swinging door, unless otherwise indicated.
 2. Stop is not required if positive stop feature is specified for door closer; positive stop feature of door closer is not an acceptable substitute for a stop, unless otherwise indicated.

2.15 PROTECTION PLATES

- A. Protection Plates: Comply with BHMA A156.6.
- B. Metal Properties: Stainless steel.
1. Metal, Heavy Duty: Thickness 0.062 inch, minimum.
- C. Edges: Beveled, on four sides unless otherwise indicated.
- D. Fasteners: Countersunk screw fasteners.
- E. Drip Guard: Provide at head of exterior doors unless covered by roof or canopy.

2.16 KICK PLATES

- A. Kick Plates: Provide along bottom edge of push side of every door with closer, except aluminum storefront and glass entry doors, unless otherwise indicated.
1. Size: 12 inch high by 2 inch less door width (LDW) on push side of door.

2.17 DOOR HOLDERS

- A. Door Holders: Comply with BHMA A156.16, Grade 1.
1. Provide surface mounted door holders when wall or floor stop is not applicable and hold-open device is mounted on door.
 2. Type: Lever, or kick down stop, with rubber bumper at bottom end.
 3. Material: Stainless steel.

2.18 FLOOR STOPS

- A. Floor Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
 - 1. Provide floor stops when wall surface is not available; be cautious not to create a tripping hazard.
 - 2. Type: Manual hold-open, with pencil floor stop.
 - 3. Material: Aluminum housing with rubber insert.

2.19 WALL STOPS

- A. Wall Stops: Comply with BHMA A156.16, Grade 1 and Resilient Material Retention Test as described in this standard.
 - 1. Provide wall stops to prevent damage to wall surface upon opening door.
 - 2. Type: Bumper, concave, wall stop.
 - 3. Material: Aluminum housing with rubber insert.

2.20 ASTRAGALS

- A. Astragals: Comply with BHMA A156.22.
 - 1. Provide recessed astragal to cover or fill space for full door height between pair of doors or door and adjacent jamb.
 - 2. Type: Split, two parts, and with sealing gasket.
 - 3. Material: Aluminum, with neoprene weatherstripping.
 - 4. Provide non-corroding fasteners at exterior locations.

2.21 THRESHOLDS

- A. Thresholds: Comply with BHMA A156.21.
 - 1. Provide threshold at interior doors for transition between two different floor types, and over building expansion joints, unless otherwise indicated.
 - 2. Provide threshold at each exterior door, unless otherwise indicated.
 - 3. Provide threshold with Sound Transmission Class (STC) of 25-30 at locations indicated.
 - 4. Type: Flat surface.
 - 5. Material: Aluminum.
 - 6. Threshold Surface: Fluted horizontal grooves across full width.
 - 7. Field cut threshold to profile of frame and width of door sill for tight fit.
 - 8. Provide non-corroding fasteners at exterior locations.

2.22 WEATHERSTRIPPING AND GASKETING

- A. Rigid Seals:
 - 1. Weatherstripping and Gasketing: Comply with BHMA A156.22.
 - a. Head and Jamb Type: Adjustable.
 - b. Door Sweep Type: Encased in retainer.
 - c. Material: Aluminum, with brush weatherstripping.
 - d. See Section 08 1416 when wood door to frame sealing system is applied by door manufacturer.

- e. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated.
- f. Provide door bottom sweep on each exterior door, unless otherwise indicated.
- g. Provide sound-rated gasketing and automatic door bottom on doors indicated as "Sound-Rated", "Acoustical", or with "Sound Transmission Class (STC) rating"; fabricate as continuous gasketing, do not cut or notch gasketing material.

B. Adhesive Seals and Bottoms:

- 1. Weatherstripping and Gasketing: Comply with BHMA A156.22.
 - a. Head and Jamb Type: Self-adhesive.
 - b. Door Sweep Type: Encased in retainer.
 - c. Material: Aluminum, with brush weatherstripping.
 - d. Refer to Section 08 14 16 when wood door to frame sealing system is applied by door manufacturer.
 - e. Provide weatherstripping on each exterior door at head, jambs, and meeting stiles of door pairs, unless otherwise indicated; .
 - f. Provide door bottom sweep on each exterior door, unless otherwise indicated.

2.23 SIGNAGE

- A. See Section 10 14 23 - Panel Signage for additional signage requirements.

2.24 SILENCERS

- A. Silencers: Provide at equal locations on door frame to mute sound of door's impact upon closing.
- 1. Single Door: Provide three on strike jamb of frame.
 - 2. Pair of Doors: Provide two on head of frame, one for each door at latch side.
 - 3. Material: Rubber, gray color.

2.25 KEY CONTROL SYSTEMS

- A. Manufacturers:
- 1. Substitutions: Not permitted.
- B. Key Control Systems: Comply with guidelines of BHMA A156.28.
- 1. Provide keying information in compliance with DHI (KSN) standards.
 - 2. Keying: Grand master keyed.
 - 3. Include construction keying and control keying with removable core cylinders.
 - a. Provide temporary keyed-alike cores.
 - b. Remove at substantial completion and install permanent cylinders/cores in District's presence.
 - 1) Demonstrate that construction key no longer operates.
 - 4. Key to existing keying system.
 - a. Factory registered master key system.
 - b. Restricted keyway, interchangeable core.
 - c. Contact District Locksmith with for keying requirements.

- d. Key blanks available only from factory-direct sources, not available from after-market key blank manufacturers.
 - e. For estimate use factory GMK charge.
 - f. Furnish District's written approval of the system.
5. Supply keys in following quantities:
 - a. 4 each Master keys.
 - b. 1 each Grand Master keys.
 - c. 6 each Construction Master keys.
 - d. 15 each Construction keys.
 - e. 2 each Construction Control keys.
 - f. 2 each Control keys if new system.
 - g. 2 each Extra Cylinder cores.
 - h. 2 each Change keys for each keyed core.
6. Key Management System: For each keyed lock on project, provide one set of consecutively numbered duplicate key tags with hanging hole and snap catch.
7. Security Key Tags: For each keyed lock on project, provide one set of matching key tags for permanent attachment to one key of each set.
8. Provide key collection envelopes, receipt cards, and index cards in quantity suitable to manage number of keys.
9. Deliver keys with identifying tags to District by security shipment direct from hardware supplier.
10. Bitting List: Use secured shipment direct from point of origination to District upon completion.
11. Permanent Keys and Cores: Stamped with applicable key marking for identification. Do not include actual key cuts within visual key control marks or codes. Stamp permanent keys "Do Not Duplicate."

2.26 KEY CABINET

- A. Key Cabinet: Sheet steel construction, piano hinged door with key lock; BHMA A156.28.
 1. Mounting: Wall-mounted.
 2. Capacity: Actual quantity of keys, plus 25 percent additional capacity.
 3. Size key hooks to hold 6 keys each.
 4. Finish: Baked enamel, manufacturer's standard color.
 5. Key cabinet lock to building keying system.

2.27 FIRE DEPARTMENT LOCK BOX

- A. Manufacturers:
 1. Knox Company; Knox-Box Rapid Entry System: www.knoxbox.com.
 2. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fire Department Lock Box: at Buildings or Site Walls
 1. Heavy-duty, recessed, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
 2. Capacity: Holds 10 keys.

3. Finish: Manufacturer's standard dark bronze.
4. Mounted to posts at manual gates (for driveways/roads) and as indicated on Drawings:
 - a. Key lock boxes shall be located at driver's side of gate entrance in a visible location as directed by Fire Department.
 - 1) Box shall be welded secure to metal posts. Box shall be 4 to 4-1/2 feet from top of box to finished grade.
 - b. Obtain approval from Fire Department of mounting location/position and operating standards before installation.
 - c. Products:
 - 1) Knox Company; Model 3208 or 3166, as applicable.
 - 2) Knox Decal 1001 shall be placed on gate.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements. Only if allowed or required by local Fire Department.
- C. Provide Knox Fire Department alert decals on all exterior doors of the facility and on all interior doors that keys have been furnished for within the lock box.
 1. If the building/facility is protected with a fire alarm system or burglar alarm system, the lock boxes shall be "tamper" monitoring.
 2. The tamper monitoring must include the following:
 - a. All central stations shall be UL listed.
 - b. For combination Fire/Burglar Alarm Panels, the Knox Box monitoring shall be through the fire side of the panel.
 - c. Central stations upon receiving a Knox Box tamper alarm signal shall:
 - 1) Notify and respond to local Police Department (Knox Box tamper).
 - 2) Notify and respond to the local Fire Department (Knox Box tamper).

2.28 FINISHES

- A. Finishes: Identified in Section 08 0671 - Door Hardware Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that doors and frames are ready to receive this work; labeled, fire-rated doors and frames are properly installed, and dimensions are as indicated on shop drawings.

3.02 INSTALLATION

- A. Install hardware in accordance with manufacturer's instructions and applicable codes.
 1. Locate hardware per SDI-100 and applicable building, fire, life-safety, accessibility, and security codes.
 2. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate for proper installation and operation. Remove and reinstall or replace work deemed defective by Architect.
 - a. Gaskets:
 - 1) Install jamb-applied gaskets before closers, overhead stops, rim strikes, etc; fasten hardware over and through these seals.

- 2) Install sweeps across bottoms of doors before astragals, cope sweeps around bottom pivots, trim astragals to tops of sweeps.
- b. Use manufacturers' fasteners furnished with hardware items, or submit Request for Substitution with Architect.
- c. Replace fasteners damaged by power-driven tools.
3. Core concrete for exterior door stop anchors. Set anchors in approved non-shrink grout.
4. Lubricate and adjust existing hardware scheduled to remain. Carefully remove and give to District items not scheduled for reuse.
- B. Use templates provided by hardware item manufacturer.
- C. Do not install surface mounted items until application of finishes to substrate are fully completed.
- D. Door Hardware Mounting Heights: Distance from finished floor to center line of hardware item. As indicated in following list; unless noted otherwise in Door Hardware Schedule or on drawings.
 1. Comply with California Building Code, Section 1010.2.3, 11B-309.4 and 11B-404.2.7.
 - a. Refer also to CBC requirements noted in Part 1 of this section.
 2. For Steel Doors and Frames: Install in compliance with DHI (LOCS) recommendations.
 3. For Steel Doors and Frames: See Section 08 11 13.
 4. For Wood Doors: Install in compliance with DHI WDHS.3 recommendations.
 5. Flush Wood Doors: See Section 08 14 16.
 6. Mounting heights in compliance with ADA Standards and CBC Chapter 11B:
 - a. Locksets: 34 to 44 inches.
 - b. Push/Pulls: 34 to 44 inches.
 - c. Dead Locks: 44 inches.
 - d. Exit Devices: 36 (clear) to 44 inches.
 - e. Where new hardware is to be installed near existing doors/hardware scheduled to remain, match locations of existing hardware when compliant with codes.
- E. Set exterior door thresholds with full-width bead of elastomeric sealant at each point of contact with floor providing a continuous weather seal; anchor thresholds with stainless steel countersunk screws.
 1. See Section 07 92 00 for additional requirements.
- F. Locate floor stops no more than 4 inches (maximum outside dimension) from walls and not within paths of travel. See Article "Hinges" in Part 2 regarding hinge widths, door should be well clear of point of wall reveal. Point of door contact no closer to the hinge edge than half the door width. Where situation is questionable or difficult, contact Architect for direction.
- G. Locate overhead stops for minimum 90 degrees at rest and for maximum allowable degree of swing.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing under provisions of Section 01 40 00 - Quality Requirements.
- B. Provide an Architectural Hardware Consultant (AHC) to inspect installation and certify that hardware and installation has been furnished and installed in accordance with manufacturer's instructions and as specified.

3.04 ADJUSTING

- A. Adjust work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Adjust hardware for smooth operation.
 - 1. Adjust and check for proper operation and function. Replace units, which cannot be adjusted to operate freely and smoothly.
 - a. Hardware damaged by improper installation or adjustment methods: repair or replace to District's satisfaction.
 - b. Adjust doors to fully latch with no more than 1 pound of pressure.
 - c. Adjust door closers per "Commissioning" article below.
- C. Adjust gasketing for complete, continuous seal; replace if unable to make complete seal.
- D. Final inspection: Installer to provide letter to District that upon completion installer has visited the Project and has accomplished the following:
 - 1. Has re-adjusted hardware.
 - 2. Has evaluated maintenance procedures and recommend changes or additions, and instructed District's personnel.
 - 3. Has identified items that have deteriorated or failed.
 - 4. Has submitted written report identifying problems.

3.05 COMMISSIONING:

- A. Conduct these tests prior to request for certificate of substantial completion:
 - 1. With installer present, test door hardware operation for compliance with push and pull force requirements per ADA and CBC.

3.06 CLEANING

- A. Clean finished hardware in accordance with manufacturer's written instructions after final adjustments have been made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Replace items that cannot be cleaned to manufacturer's level of finish quality at no additional cost.
- D. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.07 PROTECTION

- A. Protect finished Work under provisions of Section 01 70 00 - Execution and Closeout Requirements.
- B. Do not permit adjacent work to damage hardware or finish.

3.08 CLOSEOUT

- A. Return of temporary cores for return/receipt by Contractor.
- B. Final inspection: Installer to provide letter to District that upon completion installer has visited the Project and has accomplished the following:
 - 1. Has re-adjusted hardware.
 - 2. Has evaluated maintenance procedures and recommend changes or additions, and instructed District's personnel.

3. Has identified items that have deteriorated or failed.
4. Has submitted written report identifying problems.

3.09 SCHEDULE OF FINISH HARDWARE

- A. See door schedule in drawings for hardware set assignments.
- B. No hardware shall be ordered until Finish Hardware has been reviewed and approved by Architect's hardware consultant.
- C. Provide Factory order numbers for all products supplied on this project as part of close out documents for Owner's warranty records.
- D. See schedule in Section 08 06 71 - Door Hardware Schedule.

END OF SECTION

SECTION 08 80 00 GLAZING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing units.
- C. Glazing compounds.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers.
- B. Section 07 27 00 - Air Barriers.
- C. Section 07 92 00 - Joint Sealants: Sealants for other than glazing purposes.
- D. Section 08 11 13 - Hollow Metal Doors and Frames: Glazed lites in doors and borrowed lites.
- E. Section 08 14 16 - Flush Wood Doors: Glazed lites in doors.
- F. Section 08 43 13 - Aluminum-Framed Storefronts: Glazing provided as part of storefront assembly.
- G. Section 10 28 00 - Toilet Accessories: Mirrors.

1.03 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials; Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test; 2015 (Reaffirmed 2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers; 2005 (Reapproved 2019).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants; 2018.
- F. ASTM C1036 - Standard Specification for Flat Glass; 2021.
- G. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass; 2018.
- H. ASTM C1172 - Standard Specification for Laminated Architectural Flat Glass; 2019.
- I. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2016 (Reapproved 2023).
- J. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2021a.
- K. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings; 2016.
- L. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation; 2019.
- M. GANA (GM) - GANA Glazing Manual; 2022.
- N. GANA (SM) - GANA Sealant Manual; 2008.

- O. IGMA TM-3000 - North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial & Residential Use; 1990 (Reaffirmed 2016).
- P. NFRC 100 - Procedure for Determining Fenestration Product U-factors; 2023.
- Q. NFRC 200 - Procedure for Determining Fenestration Product Solar Heat Gain Coefficient and Visible Transmittance at Normal Incidence; 2023.
- R. NFRC 300 - Test Method for Determining the Solar Optical Properties of Glazing Materials and Systems; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by each of the affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data on Insulating Glass Unit and Glazing Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, special handling and installation requirements.
- C. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- D. Samples: Submit two samples 12 by 12 inch in size of glass and plastic units.
- E. Certificate: Certify that products of this section meet or exceed specified requirements.
- F. Manufacturer's qualification statement.
- G. Installer's qualification statement.
- H. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.
- I. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with GANA (GM) and IGMA TM-3000 for glazing installation methods. Maintain one copy on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years of documented experience.
 - 1. Provide certified glass products through ANSI accredited certifications that include plant audits and independent laboratory performance testing.
 - a. Insulating Glass Certification Council (IGCC).
 - b. Safety Glazing Certification Council (SGCC).
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years documented experience.
 - 1. Provide company, field supervisors, and installers that hold active ANSI accredited certifications in appropriate categories for work specified.
- D. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Provide mock-up of each type of glazing system including glass and air barrier and vapor retarder seal.
- C. Provide on-site glazing mock-up with the specified glazing components.
- D. Locate where directed.
- E. Mock-ups may remain as part of the Work.

1.08 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Insulating Glass Units: Provide a five (5) year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.
- C. Laminated Glass: Provide a five (5) year manufacturer warranty to include coverage for delamination, including providing products to replace failed units.
- D. Heat Soaked Tempered Glass: Provide a five (5) year manufacturer warranty to include coverage for spontaneous breakage of fully tempered glass caused by nickel sulfide (NiS) inclusions.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with the all applicable codes and ordinances, including California Building Code (CBC), Title 24, Part 2, Chapter 24 as amended and adopted by authorities having jurisdiction, and US Consumer Product Safety Commission Standard 16 CFR 1201 CI and CII.
- B. Where safety glass is indicated or required, provide glazing materials that conform to ANSI Z97.1 and CPSC 16 CFR 1201 and are so identified in accordance with CBC Section 2406.3.
- C. Glass Identification: Per CBC Section 2403.1, each light shall bear the manufacturer's label designating the type and thickness of glass.
 - 1. When approved by the enforcement agency, labels may be omitted from other than safety glazing materials, provided an affidavit is furnished by the glazing contractor certifying that each light is glazed in accordance with approved plans and specifications.
 - 2. Identification of safety glazing material installed in hazardous locations as defined in Section 2406 of this chapter shall be identified by label which will specify the labeler, whether the manufacturer or installer, and state that safety glazing material has been utilized in such installations.
 - 3. The label shall be legible and visible from the inside of the building after installation and shall specify that label shall not be removed.
 - 4. Tempered glass shall have an etched manufacturer's label.

2.02 MANUFACTURERS

A. Glass Fabricators:

1. Glass Fab; www.glassfabusa.com.
2. Glasswerks Inc.; www.glasswerks.com.
3. GlasPro, Inc.; www.glas-pro.com
4. Viracon, Inc; www.viracon.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

B. Float Glass Manufacturers:

1. Cardinal Glass Industries; www.cardinalcorp.com/#sle.
2. GlasPro, Inc.; www.glas-pro.com
3. Guardian Glass, LLC; www.guardianglass.com/#sle.
4. Pilkington North America Inc; www.pilkington.com/na/#sle.
5. Saint Gobain North America; www.saint-gobain.com/#sle.
6. Vitro Architectural Glass (formerly PPG Glass); www.vitroglazings.com/#sle.
7. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 PERFORMANCE REQUIREMENTS - EXTERIOR GLAZING ASSEMBLIES

A. Provide type and thickness of exterior glazing assemblies to support assembly dead loads, and to withstand live loads caused by positive and negative wind pressure acting normal to plane of glass.

1. Design Pressure: Calculated in accordance with ASCE 7.
 - a. Where glass thicknesses are not indicated, provide thickness based on the wind pressures required by the California Building Code (CBC), Title 24, Part 2, 2403 and 2404, wind pressure shall be assumed to have a one minute duration.
 - b. Upon first application of design wind load for the specified durations, probability of breakage shall not exceed 8/1000 for vertical glass.
 - c. Probability of breakage relative to glass thermal stress shall not exceed 8/1000 for vertical glass.
2. Comply with ASTM E1300 for design load resistance of glass type, thickness, dimensions, and maximum lateral deflection of supported glass.
3. Seismic Loads: Design and size glazing components to withstand seismic loads and sway displacement in accordance with the requirements of ASCE 7
4. Provide glass edge support system sufficiently stiff to limit the lateral deflection of supported glass edges to less than 1/175 of their lengths under specified design load.
5. Glass thicknesses listed are minimum.

B. Weather-Resistive Barrier Seals: Provide completed assemblies that maintain continuity of building enclosure water-resistive barrier, vapor retarder, and/or air barrier.

1. In conjunction with weather barrier related materials described in other sections, as follows:
 - a. Water-Resistive Barriers: See Section 07 25 00.
 - b. Air Barriers: See Section 07 27 00.
2. To utilize inner pane of multiple pane insulating glass units for continuity of vapor retarder and/or air barrier seal.

3. To maintain a continuous vapor retarder and/or air barrier throughout glazed assembly from glass pane to heel bead of glazing sealant.
- C. Thermal and Optical Performance: Provide exterior glazing products with performance properties as indicated. Performance properties are in accordance with manufacturer's published data as determined with the following procedures and/or test methods:
 1. Center of Glass U-Value: Comply with NFRC 100 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 2. Center of Glass Solar Heat Gain Coefficient (SHGC): Comply with NFRC 200 using Lawrence Berkeley National Laboratory (LBNL) WINDOW 6.3 computer program.
 3. Solar Optical Properties: Comply with NFRC 300 test method.

2.04 GLASS MATERIALS

- A. Float Glass: Provide float glass based glazing unless otherwise indicated.
 1. Annealed Type: ASTM C1036, Type I - Transparent Flat, Class 1 - Clear, Quality - Q3.
 2. Kind HS - Heat-Strengthened Type: Complies with ASTM C1048.
 3. Kind FT - Fully Tempered Type: Complies with ASTM C1048.
 4. Fully Tempered Safety Glass: Complies with ANSI Z97.1 or 16 CFR 1201 criteria for safety glazing used in hazardous locations.
 5. Heat-Soak Testing (HST): Provide HST of fully tempered glass used on high-risk or other demanding applications of project, to reduce risks of spontaneous breakage due to nickel sulfide (NiS) induced fractures in accordance with industry established testing requirements.
 6. Impact Resistant Safety Glass: Complies with ANSI Z97.1 - Class A, or 16 CFR 1201 - Category II criteria. CBC 2406.2.
 7. Tinted Type: ASTM C1036, Class 2 - Tinted, Quality - Q3, with color and performance characteristics as indicated.
 8. Thicknesses: As indicated; provide greater thickness as required for exterior glazing wind load design.
- B. Laminated Glass: Float glass laminated in accordance with ASTM C1172.
 1. Laminated Safety Glass: Complies with ANSI Z97.1 - Class B or 16 CFR 1201 - Category I impact test requirements.
 2. Ionoplast Interlayer: 0.035 inch thick, minimum.
 - a. Basis of Design Product: SentryGlas®Plus (SGB) Interlayer as manufactured by Kuraray America Inc., www.kuraray.us.com, or approved equal.

2.05 INSULATING GLASS UNITS

- A. Manufacturers:
 1. Glass: Any of the manufacturers specified for float glass.
 2. Cardinal Glass Industries: www.cardinalcorp.com/#sle.
 3. Glasswerks: glasswerks.com.
 4. Pilkington North America Inc: www.pilkington.com/na/#sle.
 5. Viracon, Apogee Enterprises, Inc: www.viracon.com/#sle.
 6. Vitro Architectural Glass (formerly PPG Glass): www.vitroglazings.com/#sle.
 7. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

- B. Fabricator: Certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
- C. Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 - 3. Metal-Edge Spacers: Aluminum, bent and soldered corners.
 - 4. Spacer Color: Black.
 - 5. Edge Seal:
 - a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
 - b. Color: Black.
 - 6. Purge interpane space with dry air, hermetically sealed.
 - 7. Capillary Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet between point of fabrication and point of installation to permit pressure equalization of air space.
 - a. Capillary Tubes: Tubes to remain open and be of length and material type in accordance with insulating glass fabricator's requirements.
 - b. Inert gas may be installed in the field into air space in accordance with insulating glass fabricator's and installer's requirements.
- D. Insulating Glass Units: Vision glass, double glazed.
 - 1. Applications: Exterior glazing unless otherwise indicated.
 - 2. Space between lites filled with air.
 - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 - 4. Metal edge spacer.
 - 5. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - 6. Total Thickness: 1 inch.
 - 7. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.29, nominal.
 - 8. Visible Light Transmittance (VLT): 51 percent, nominal.
 - 9. Solar Heat Gain Coefficient (SHGC): 0.23, nominal.
 - 10. Visible Light Reflectance, Outside: 12 percent, nominal.
 - 11. Glazing Method: Dry glazing method, gasket glazing.
- E. Insulating Glass Units: Spandrel glazing.
 - 1. Applications: Exterior spandrel glazing unless otherwise indicated.
 - 2. Space between lites filled with air.
 - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.

- b. Coating: Same as on vision units, on #2 surface.
 - 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Opacifier: Ceramic frit, on #4 surface.
 - 5. Total Thickness: 1 inch.
 - 6. Glazing Method: Dry glazing method, gasket glazing.
- F. Insulating Glass Units: Safety glazing.
 - 1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 - 2. Space between lites filled with air.
 - 3. Glass Type: Same as other vision glazing except use fully tempered float glass for both outboard and inboard lites.
 - 4. Tint: Clear.
 - 5. Total Thickness: 1 inch.
 - 6. Metal edge spacer.
 - 7. Glazing Method: Dry glazing method, gasket glazing.

2.06 BASIS OF DESIGN - INSULATING GLASS UNITS

- A. Basis of Design - Insulating Glass Units: Vision glazing, with low-e coating.
 - 1. Applications: Exterior insulating glass glazing unless otherwise indicated.
 - 2. Space between lites filled with air.
 - 3. Total Thickness: 1 inch.
 - 4. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.28, nominal.
 - 5. Visible Light Transmittance (VLT): 64 percent, nominal.
 - 6. Solar Heat Gain Coefficient (SHGC): 0.27, nominal.
 - 7. Visible Light Reflectance, Outside: 12 percent, nominal.
 - 8. Glazing Method: Dry glazing method, gasket glazing.
 - 9. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 10. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 - 11. Metal Edge Spacers: Aluminum, bent and soldered corners.
 - 12. Spacer Color: Black.
 - 13. Edge Seal:
 - a. Single-Sealed System: Provide silicone, polysulfide, or polyurethane sealant as seal applied around perimeter.
 - b. Color: Black.
 - 14. Purge interpane space with dry air, hermetically sealed.

15. Capillary Tubes: Provide tubes from air space for insulating glass units without inert type gas that have a change of altitude greater than 2500 feet between point of fabrication and point of installation to permit pressure equalization of air space.
 - a. Capillary Tubes: Tubes to remain open and be of length and material type in accordance with insulating glass fabricator's requirements.
- B. Basis of Design - Vitro Architectural Glass (formerly PPG Glass):
www.vitroglazings.com/#sle.
 1. Outboard Lite: Heat-strengthened float glass, 1/4 inch thick, minimum.
 - a. Low-E Coating: Vitro Architectural Glass (formerly PPG Glass) Solarban 90 on #2 surface.
 - b. Glass: Clear.
 2. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
 - a. Coating: No coating on inboard lite.
 - b. Glass: Clear.
- C. Substitution Procedures: See Section 01 60 00 - Product Requirements.
 1. For any product not identified as "Basis of Design", submit information as specified for substitutions.

2.07 GLAZING UNITS

- A. Monolithic Interior Vision Glazing:
 1. Applications: Interior glazing unless otherwise indicated.
 2. Glass Type: Annealed float glass.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
- B. Monolithic Safety Glazing: Non-fire-rated.
 1. Applications:
 - a. Glazed lites in doors, except fire doors.
 - b. Glazed sidelights to doors, except in fire-rated walls and partitions.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 - d. Other locations indicated on drawings.
 2. Glass Type: Fully tempered safety glass as specified.
 3. Tint: Clear.
 4. Thickness: 1/4 inch, nominal.
 5. Glazing Method: Dry glazing method, gasket glazing.

2.08 GLAZING COMPOUNDS

- A. Type GC-3 - Polysulfide Sealant: Two component; chemical curing, nonsagging type; ASTM C920 Type M, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.
- B. Type GC-5 - Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; nonbleeding, nonstaining; ASTM C920 Type S, Grade NS, Class 25, Uses M, A, and G; with cured Shore A hardness range of 15 to 25; color as selected.

2.09 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 - 1. Width: As required for application.
 - 2. Thickness: As required for application.
- D. Glazing Gaskets: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.
- E. Glazing Clips: Manufacturer's standard type.

2.10 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.

PART 3 EXECUTION

3.01 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that the minimum required face and edge clearances are being provided.
- C. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.
- D. Verify that sealing between joints of glass framing members has been completed effectively.
- E. Proceed with glazing system installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.03 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.

- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites of system with uniform pattern, draw, bow, and similar characteristics.
- E. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- F. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, and paint.

3.04 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Glass and Glazing product manufacturers to provide field surveillance of the installation of their products.
- C. Monitor and report installation procedures and unacceptable conditions.

3.06 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- C. Remove nonpermanent labels immediately after glazing installation is complete.
- D. Clean glass and adjacent surfaces after sealants are fully cured.
- E. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.07 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

SECTION 09 05 61 COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. This section applies to floors identified in Contract Documents that are receiving the following types of floor coverings:
 - 1. Resilient tile and sheet.
 - a. Moisture vapor seal is required at all locations to receive resilient flooring regardless of moisture test.
 - 2. Broadloom carpet.
 - a. Sealer is not needed under Tandus Power Bond Carpet.
 - 3. Carpet tile.
 - a. Sealer is not needed under Tandus Power Bond Carpet.
 - b. Moisture vapor seal is required at all locations to receive fluid-applied flooring regardless of moisture test.
 - 4. Thin-set ceramic tile and stone tile.
 - 5. Fluid-Applied flooring
 - a. Moisture vapor seal is required at all locations to receive fluid-applied flooring regardless of moisture test.
- B. Removal of existing floor coverings.
- C. Preparation of new and existing concrete floor slabs for installation of floor coverings.
- D. Testing of concrete floor slabs for moisture and alkalinity (pH).
- E. Remediation of concrete floor slabs due to unsatisfactory moisture or alkalinity (pH) conditions.
 - 1. Contractor shall perform all specified remediation of concrete floor slabs. If such remediation is indicated by testing agency's report and is due to a condition not under Contractor's control or could not have been predicted by examination prior to entering into the contract, a contract modification will be issued.
- F. Patching compound.
- G. Remedial floor coatings.
- H. Remedial floor sheet membrane.
- I. Preparation of new and existing wood-based floors and subfloors for installation of new floor coverings.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements: Additional requirements relating to testing agencies and testing.
- B. Section 01 74 19 - Construction Waste Management and Disposal: Handling of existing floor coverings removed.

- C. Section 03 30 00 - Cast-in-Place Concrete: Moisture emission reducing curing and sealing compound for slabs to receive adhered flooring, to prevent moisture content-related flooring failures; to remain in place, not to be removed.
- D. Section 03 30 00 - Cast-in-Place Concrete: Limitations on curing requirements for new concrete floor slabs.

1.03 REFERENCE STANDARDS

- A. ASTM C109/C109M - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 50 mm [2 in.] Cube Specimens); 2023.
- B. ASTM C472 - Standard Test Methods for Physical Testing of Gypsum, Gypsum Plasters, and Gypsum Concrete; 2020.
- C. ASTM D4259 - Standard Practice for Preparation of Concrete by Abrasion Prior to Coating Application; 2018.
- D. ASTM F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring; 2022.
- E. ASTM F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride; 2023.
- F. ASTM F2170 - Standard Test Method for Determining Relative Humidity in Concrete Floor Slabs Using in situ Probes; 2019a.
- G. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings; 2018.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate scheduling of cleaning and testing, so that preliminary cleaning has been completed for at least 24 hours prior to testing.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Visual Observation Report: For existing floor coverings to be removed.
- C. Floor Covering and Adhesive Manufacturers' Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
 - 1. Moisture and alkalinity (pH) limits and test methods.
 - 2. Manufacturer's required bond/compatibility test procedure.
- D. Remedial Materials Product Data: Manufacturer's published data on each product to be used for remediation.
 - 1. Manufacturer's qualification statement.
 - 2. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.
 - 3. Manufacturer's installation instructions.
 - 4. Specimen Warranty: Copy of warranty to be issued by coating manufacturer and certificate of underwriter's coverage of warranty.
- E. Testing Agency's Report:
 - 1. Description of areas tested; include floor plans and photographs if helpful.
 - 2. Summary of conditions encountered.
 - 3. Moisture and alkalinity (pH) test reports.
 - 4. Copies of specified test methods.

- 5. Recommendations for remediation of unsatisfactory surfaces.
- 6. Submit report directly to District.
- 7. Submit report not more than two business days after conclusion of testing.
- F. Adhesive Bond and Compatibility Test Report.
- G. Floor Moisture Testing Technician Certificate: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician- Grade I certificate.
- H. Copy of RFCI (RWP).

1.06 QUALITY ASSURANCE

- A. Moisture and alkalinity (pH) testing will be performed by an independent testing agency employed and paid by District.
- B. Contractor may perform additional adhesive and bond test with Contractor's own personnel or hire a testing agency.
- C. Testing Agency Qualifications: Independent testing agency experienced in the types of testing specified.
 - 1. Submit evidence of experience consisting of at least 3 test reports of the type required, with project District's project contact information.
- D. Contractor's Responsibility Relating to Independent Agency Testing:
 - 1. Provide access for and cooperate with testing agency.
 - 2. Confirm date of start of testing at least 10 days prior to actual start.
 - 3. Allow at least 4 business days on site for testing agency activities.
 - 4. Achieve and maintain specified ambient conditions.
 - 5. Notify District when specified ambient conditions have been achieved and when testing will start.
- E. Floor Moisture Testing Technician Qualifications: International Concrete Repair Institute (ICRI) Concrete Slab Moisture Testing Technician Certification- Grade I.
- F. Remedial Coating Installer Qualifications: Company specializing in performing work of the type specified in this section, trained by or employed by coating manufacturer, and able to provide at least 3 project references showing at least 3 years' experience installing moisture emission coatings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, handle, and protect products in accordance with manufacturer's instructions and recommendations.
- B. Deliver materials in manufacturer's packaging; include installation instructions.
- C. Keep materials from freezing.

1.08 FIELD CONDITIONS

- A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 65 degrees F or more than 85 degrees F.
- B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours prior to testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Patching Compound: Floor covering manufacturer's recommended product, suitable for conditions, and compatible with adhesive and floor covering. In the absence of any recommendation from flooring manufacturer, provide a product with the following characteristics:
1. Cementitious moisture-, mildew-, and alkali-resistant compound, compatible with floor, floor covering, and floor covering adhesive, and capable of being feathered to nothing at edges.
 2. Latex or polyvinyl acetate additions are permitted; gypsum content is prohibited.
 3. Compressive Strength: 3000 psi, minimum, after 28 days, when tested in accordance with ASTM C109/C109M or ASTM C472, whichever is appropriate.
 4. Products:
 - a. ARDEX Engineered Cements; ARDEX Feather Finish: www.ardexamericas.com/#sle.
 - b. Floor Seal Technology, Inc; Color Match Patch: www.floorseal.com/#sle.
 - c. H.B. Fuller Construction Products, Inc; TEC Feather Edge Skim Coat: www.tecspecialty.com/#sle.
 - d. Mapei International; Mapei Ultraplan 1 Plus: www.mapei.com.
 - e. Sika Corporation; Sika Level-315: www.sikafloorusa.com.
 - f. USG Corporation; Durock Brand Advanced Skim Coat Floor Patch: www.usg.com/#sle.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Alternate Flooring Adhesive: Floor covering manufacturer's recommended product, suitable for the moisture and pH conditions present; low-VOC. In the absence of any recommendation from flooring manufacturer, provide a product recommended by adhesive manufacturer as suitable for substrate and floor covering and for conditions present.
- C. Remedial Floor Coating: Single- or multi-layer coating or coating/overlay combination intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
1. Thickness: As required for application and in accordance with manufacturer's installation instructions.
 2. Products:
 - a. ARDEX Engineered Cements; ARDEX VB 100: www.ardexamericas.com/#sle.
 - b. Custom Building Products; TechMVC Moisture Vapor and Alkalinity Barrier: www.custombuildingproducts.com/#sle.
 - c. Floor Seal Technology, Inc; MES 100 with Floor Seal FloorCem SLU: www.floorseal.com/#sle.
 - d. Koster American Corporation; Koster VAP I 2000 with Koster SL Premium overlay: www.kosterusa.com/#sle.
 - e. LATICRETE International, Inc; LATICRETE VAPOR BAN E with LATICRETE NXT LEVEL PLUS: www.laticrete.com/#sle.

- f. Maxxon Corporation; Aquafin SG4: www.maxxon.com/#sle.
 - g. Sika Corporation; Sikafloor Moisture Tolerance Epoxy Primer and Sikafloor Self-Leveling Moisture Tolerant Resurfacer: www.sikafloorusa.com/#sle.
 - h. USG Corporation; Durock CoverPrep: www.usg.com/#sle.
 - i. Substitutions: See Section 01 60 00 - Product Requirements.
- D. Remedial Floor Sheet Membrane: Pre-formed multi-ply sheet membrane installed over concrete subfloor and intended by its manufacturer to resist water vapor transmission to degree sufficient to meet flooring manufacturer's emission limits, resistant to the level of alkalinity (pH) found, and suitable for adhesion of flooring without further treatment.
 - 1. Thickness: 28 mil (0.028 inch).
 - 2. Tape: Types recommended by underlayment manufacturer to install membrane and cover seams.
 - 3. Products:
 - a. GCP Applied Technologies: www.gcpat.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

PART 3 EXECUTION

3.01 CONCRETE SLAB PREPARATION

- A. Follow recommendations of testing agency.
- B. Perform following operations in the order indicated:
 - 1. Existing concrete slabs (on-grade and elevated) with existing floor coverings:
 - a. Visual observation of existing floor covering, for adhesion, water damage, alkaline deposits, and other defects.
 - b. Removal of existing floor covering.
 - 2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
 - a. Do not attempt to remove coating or penetrating material.
 - b. Do not abrade surface.
 - c. Remove existing coatings and curing agents from surface according to recommendations of remedial coating manufacturer.
 - d. Prepare surface according to recommendations of remedial coating manufacturer and according to ASTM D4259.
 - 3. Preliminary cleaning.
 - 4. Moisture vapor emission tests; 3 tests in the first 1000 square feet and one test in each additional 1000 square feet, unless otherwise indicated or required by flooring manufacturer.
 - 5. Internal relative humidity tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 6. Alkalinity (pH) tests; in same locations as moisture vapor emission tests, unless otherwise indicated.
 - 7. Specified remediation, if required.
 - 8. Patching, smoothing, and leveling, as required.
 - 9. Other preparation specified.

10. Adhesive bond and compatibility test.
11. Protection.

C. Remediations:

1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct this condition before doing any other remediation; re-test after correction.
2. Excessive Moisture Emission or Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating or remedial sheet membrane over entire suspect floor area.
3. Excessive Alkalinity (pH): If remedial floor coating is necessary to address excessive moisture, no additional remediation is required; if not, if an adhesive that is resistant to the level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.02 REMOVAL OF EXISTING FLOOR COVERINGS

- A. Comply with local, State, and federal regulations and recommendations of RFCI (RWP), as applicable to floor covering being removed.
- B. Dispose of removed materials in accordance with local, State, and federal regulations and as specified.

3.03 PRELIMINARY CLEANING

- A. Clean floors of dust, solvents, paint, wax, oil, grease, asphalt, residual adhesive, adhesive removers, film-forming curing compounds, sealing compounds, alkaline salts, excessive laitance, mold, mildew, and other materials that might prevent adhesive bond.
- B. Do not use solvents or other chemicals for cleaning.

3.04 MOISTURE VAPOR EMISSION TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F1869 and as follows.
- D. Plastic sheet test and mat bond test may not be substituted for the specified ASTM test method, as those methods do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if test values exceed 3 pounds per 1000 square feet per 24 hours.
- F. Report: Report the information required by the test method.

3.05 INTERNAL RELATIVE HUMIDITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. Where this specification conflicts with the referenced test method, comply with the requirements of this section.
- C. Test in accordance with ASTM F2170 Procedure A and as follows.

- D. Testing with electrical impedance or resistance apparatus may not be substituted for the specified ASTM test method, as the values determined are not comparable to the ASTM test values and do not quantify the moisture content sufficiently.
- E. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.
- F. Report: Report the information required by the test method.

3.06 ALKALINITY TESTING

- A. Where the floor covering manufacturer's requirements conflict with either the referenced test method or this specification, comply with the manufacturer's requirements.
- B. The following procedure is the equivalent of that described in ASTM F710, repeated here for the Contractor's convenience.
 - 1. Use a wide range alkalinity (pH) test paper, its associated chart, and distilled or deionized water.
 - 2. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity (pH) test paper into the water, remove it, and compare immediately to chart to determine alkalinity (pH) reading.
 - 3. Use of a digital pH meter with probe is acceptable; follow meter manufacturer's instructions.
- C. In the event that test values exceed floor covering manufacturer's limits, perform remediation as indicated. In the absence of manufacturer limits, perform remediation if alkalinity (pH) test value is over 10.

3.07 PREPARATION

- A. Protection of In-Place Conditions: Where indicated as contaminated to remain.
- B. See individual floor covering section(s) for additional requirements.
- C. Comply with recommendations of testing agency.
- D. Comply with requirements and recommendations of floor covering manufacturer.
- E. Fill and smooth surface cracks, grooves, depressions, control joints and other non-moving joints, and other irregularities with patching compound.
- F. Do not fill expansion joints, isolation joints, or other moving joints.

3.08 ADHESIVE BOND AND COMPATIBILITY TESTING

- A. Comply with requirements and recommendations of floor covering manufacturer.

3.09 APPLICATION OF REMEDIAL FLOOR COATING

- A. Comply with requirements and recommendations of coating manufacturer.
- B. Install remedial coating over all concrete floor areas where moisture emission and/or alkalinity exceeds the floor covering manufacturer's published limits.
- C. Prepare floor areas to be coated in accordance with coating manufacturer's requirements.
 - 1. Mask and protect adjacent wall and floor surfaces from damage due to this work.
- D. Apply coating using manufacturer's recommended procedures.
- E. Apply 1/8 inch thick cementitious surfacing over coating in areas to receive adhesively applied floor coverings.

- F. Verify that prepared floor slab has moisture emission rate and alkalinity meeting requirements.

3.10 APPLICATION OF REMEDIAL FLOOR TREATMENT

- A. Comply with requirements and recommendations of treatment manufacturer.

3.11 INSTALLATION OF REMEDIAL FLOOR SHEET MEMBRANE

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

3.12 PROTECTION

- A. Cover prepared floors with building paper or other durable covering.

END OF SECTION

SECTION 09 21 16 GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Acoustic insulation.
- C. Gypsum sheathing.
- D. Cementitious backing board.
- E. Gypsum wallboard.
- F. Joint treatment and accessories.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Building framing and sheathing.
- B. Section 07 21 00 - Thermal Insulation: Acoustic insulation.
- C. Section 07 25 00 - Weather Barriers: Water-resistive barrier over sheathing.
- D. Section 07 92 00 - Joint Sealants: Sealing acoustical gaps in construction other than gypsum board or plaster work.

1.03 REFERENCE STANDARDS

- A. AAMA 611 - Specification for Anodized Architectural Aluminum.
- B. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- C. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- D. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- E. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
- F. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board.
- G. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
- H. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board.
- I. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base.
- J. ASTM C1177/C1177M - Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- K. ASTM C1280 - Standard Specification for Application of Exterior Gypsum Panel Products for Use as Sheathing.
- L. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units.
- M. ASTM C1396/C1396M - Standard Specification for Gypsum Board.

- N. ASTM C1629/C1629M - Standard Classification for Abuse-Resistant Nondecorated Interior Gypsum Panel Products and Fiber-Reinforced Cement Panels.
- O. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber.
- P. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- Q. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
- R. ASTM E413 - Classification for Rating Sound Insulation.
- S. GA-216 - Application and Finishing of Gypsum Panel Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Install service utilities in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data:
 - 1. Joint Treatment Materials: Submit manufacturer's product data, indicating VOC content.
- C. Shop Drawings: Indicate special details associated with acoustic seals.
- D. Installer's Qualification Statement.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.
- B. Regulatory Requirements: Conform to California Building Code (CBC), Title 24, Part 2, Chapter 7, Chapter 8, and Chapter 25, as amended and adopted by authorities having jurisdiction.
- C. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions, erection drawings, and shop drawings.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 74 19 - Construction Waste Management and Disposal for packaging waste requirements.
- B. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.
- C. Store metal products to prevent corrosion.

1.08 DELIVERY, STORAGE AND HANDLING

- A. Deliver gypsum board and accessories in manufacturer's original unopened containers, bundles or rolls bearing manufacturer's identification.

- B. Store materials inside the building or in other dry weather tight 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.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide 1-year manufacturer warranty for manufacturing defects. Complete forms in District's name and register with manufacturer.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
 - 1. See PART 3 for finishing requirements.
- B. Interior Partitions, Indicated as Acoustic: Provide completed assemblies with the following characteristics:
 - 1. Acoustic Attenuation: STC as indicated calculated in accordance with ASTM E413, based on tests conducted in accordance with ASTM E90.
- C. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions in accordance with ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
 - 1. Local authorities having jurisdiction.

2.02 BOARD MATERIALS

- A. General: Gypsum board, joint treatment and finishing materials shall be manufactured from asbestos-free materials.
- B. Manufacturers - Gypsum-Based Board:
 - 1. CertainTeed Corporation: www.certainteed.com/#sle.
 - 2. Georgia-Pacific Gypsum: www.gpgypsum.com/#sle.
 - 3. National Gypsum Company: www.nationalgypsum.com/#sle.
 - 4. USG Corporation: www.usg.com/#sle.
 - 5. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
 - 1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
 - 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
 - b. Mold resistant board is required in restrooms, janitor's closets, and where indicated on Drawings.
 - 3. Thickness:
 - a. Vertical Surfaces: 5/8 inch.

- b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.
 - 4. Mold-Resistant, Paper-Faced Products:
 - a. Georgia-Pacific Gypsum; ToughRock Mold-Guard: www.gpgypsum.com/#sle.
 - b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold-Guard: www.gpgypsum.com/#sle.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Gypsum Board: www.goldbondbuilding.com/#sle.
 - d. USG Corporation; Sheetrock Brand EcoSmart Panels Mold Tough Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Abuse Resistant Wallboard:
 - 1. Application: High-traffic areas indicated.
 - a. Restrooms.
 - b. Multi-Purpose Room.
 - c. Storage Rooms.
 - d. Areas as indicated on Drawings.
 - e. Provide up to 96 inches, minimum.
 - 2. Surface Abrasion: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 3. Indentation: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 4. Soft Body Impact: Level 1, minimum, when tested in accordance with ASTM C1629/C1629M.
 - 5. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 - 6. Paper-Faced Type: Gypsum wallboard, as defined in ASTM C1396/C1396M.
 - 7. Type: Fire-resistance-rated Type X, UL or WH listed.
 - 8. Thickness: 5/8 inch.
 - 9. Edges: Tapered.
 - 10. Paper-Faced Products:
 - a. CertainTeed Corporation; Extreme Abuse Resistant Drywall with M2Tech: www.certainteed.com/#sle.
 - b. Georgia-Pacific Gypsum; ToughRock Fireguard X Mold Guard Abuse-Resistant: www.gpgypsum.com/#sle.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Hi-Abuse Gypsum Board: www.goldbondbuilding.com/#sle.
 - d. USG Corporation; Sheetrock Brand Mold Tough AR Firecode X 5/8 in. (15.9 mm): www.usg.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Backing Board For Wet Areas:
 - 1. Application: Surfaces behind tile in wet areas, including manufactured housing, tub and shower surrounds, and shower ceilings.

2. Application: Horizontal surfaces behind tile in wet areas including countertops.
 3. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 4. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
 - a. Thickness: 1/2 inch.
 - b. Products:
 - 1) Custom Building Products; Wonderboard:
www.custombuildingproducts.com/#sle.
 - 2) PermaBASE Building Products, LLC provided by National Gypsum Company; PermaBase Cement Board: www.goldbondbuilding.com/#sle.
 - 3) USG Corporation; Fiberock Brand Aqua-Tough AR Interior Panels Regular 1/2 in. (12.7 mm): www.usg.com/#sle.
 - 4) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- F. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
1. Application: Vertical surfaces behind thinset tile, except in wet areas.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Type X Thickness: 5/8 inch.
 4. Regular Board Thickness: 5/8 inch.
 5. Edges: Tapered.
 6. Products:
 - a. CertainTeed Corporation; ProRoc Brand Moisture & Mold Resistant Gypsum Board.
 - b. Georgia-Pacific Gypsum; ToughRock Mold-Guard Gypsum Board:
www.gpgypsum.com/#sle.
 - c. Lafarge North America Inc; Mold Defense Drywall.
 - d. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond XP Fire-Shield Gypsum Board: www.goldbondbuilding.com/#sle.
 - e. USG Corporation; Sheetrock Brand Mold Tough Gypsum Panels.
 - f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- G. Exterior Sheathing Board: Sizes to minimize joints in place; ends square cut.
1. Application: Exterior sheathing, unless otherwise indicated.
 - a. Where plywood sheathing is not indicated.
 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
 3. Glass Mat Faced Sheathing: Glass mat faced gypsum substrate as defined in ASTM C1177/C1177M.
 4. At Assemblies Indicated with Fire-Resistance Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
 5. Core Type: Regular and Type X, as indicated.
 6. Type X Thickness: 5/8 inch.
 7. Regular Board Thickness: 5/8 inch.

8. Edges: Square, for vertical application or horizontal.
9. Glass Mat Faced Products:
 - a. CertainTeed Corporation; GlasRoc Type X Exterior Sheathing: www.certainteed.com/#sle.
 - b. Georgia-Pacific Gypsum; DensGlass Sheathing: www.gpgypsum.com/#sle.
 - c. Gold Bond Building Products, LLC provided by National Gypsum Company; Gold Bond eXP Fire-Shield Sheathing: www.goldbondbuilding.com/#sle.
 - d. USG Corporation; Securock Brand UltraLight Glass-Mat Sheathing 1/2 in. (12.7 mm): www.usg.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.03 GYPSUM BOARD ACCESSORIES

- A. Acoustic Insulation: ASTM C665; preformed glass fiber, friction fit type, unfaced. Thickness: Fill the stud wall cavity.
 1. Application:
 - a. Partitions with STC Rating:
 - 1) Insulation fill at gypsum board partition stud framing.
 - 2) Surround penetrations in gypsum board partitions.
 - b. Gypsum board ceilings adjacent to sound-rated partitions.
 2. Surface Burning Characteristics as per ASTM E84: Flame Spread of 10; Smoke Developed of 10.
 3. Products:
 - a. Owens-Corning; Sound Attenuation Batts: www.owenscorning.com.
 - b. CertainTeed; "NoiseReducer" Sound Attenuation Batts: www.certainteed.com.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Acoustic Foam Tape: 2 inch wide by 1/4 inch thick neoprene foam gasket/sealing tape.
 1. SCE-41 Grade Neoprene sponge with a rubber based adhesive one side.
 2. Adhesive to utilize a white Kraft paper liner.
- C. Water-Resistive Barrier: See Section 07 25 00.
- D. Beads, Joint Accessories, and Other Trim: ASTM C1047, galvanized steel, unless noted otherwise.
 1. Manufacturers - Finishing Accessories:
 - a. Flannery, Inc.: flannerytrim.com.
 - b. Fry Reglet: fryreglet.com.
 - c. Phillips Manufacturing Co: www.phillipsmfg.com.
 - d. Pittcon Industries: www.pittconinsutries.com
 - e. Trim-tex, Inc.: www.trim-tex.com.
 - f. CEMCO Products, Inc; www.cemco.com.
 - g. USG Corporation: www.usg.com
 - h. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2. Corner Beads: Low profile, for 90 degree outside corners.
 - a. Cornerbead: USG Sheetrock B1 XW EL, or equal.
 - b. L Trim: USG Paper-faced "L" trim, B4 or equal.
3. Architectural Reveal Beads:
 - a. Shapes: As indicated on drawings.
 - b. Basis of Design Manufacturer: Fry Reglet: fryreglet.com.
 - 1) Reveal molding: Molding to create a vertical or horizontal recessed reveal.
 - (a) Acceptable product: Number DRM.
 - 2) "F" reveal molding: Trim reveal molding forming wall trim reveal where drywall terminates against sill, jamb, ceiling or other finish material in same plane.
 - (a) Acceptable product: Number DRMF.
 - (b) Dimensions: As indicated on drawings.
 - (c) Radius: As indicated on drawings.
 - c. Materials and Finish:
 - 1) Interior Aluminum Surfaces: Extruded; Clear medium etched.
 - (a) Architectural 200R1 medium etch: AAMA 611 AA-M32C10A21 Clear color.
 - (b) Apply one coat of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials.
- E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
 1. Fiberglass Tape: 2 inch wide, coated glass fiber tape for joints and corners, except as otherwise indicated.
 2. Joint Compound: Setting type, field-mixed.
- F. High Build Drywall Surfacers: Vinyl acrylic latex-based coating for spray application, designed to take the place of skim coating and separate paint primer in achieving Level 5 finish.
 1. Products:
 - a. CertainTeed Corporation; Level V Wall and Ceiling Primer/Surfacer with M2Tech: www.certainteed.com/#sle.
 - b. USG Corporation; USG Sheetrock Brand Tuff-Hide Primer-Surfacer: www.usg.com/#sle.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- G. Abuse Resistant Finishes:
 1. Acrylic, water-based, non-textured, high build, tintable primer and surfacer.
- H. Staples For Attachment of Base Ply of Two-Ply Assembly to Wood Members: Flattened galvanized wire type as specified in ASTM C840.
- I. Anchorage to Substrate: Tie wire, nails, screws, and other metal supports, of type and size to suit application; to rigidly secure materials in place.
- J. Adhesives
 1. Do not use adhesive containing benzene, carbon tetrachloride, or trichloroethylene.
 - a. Adhesive shall contain a maximum VOC content of 50 grams per liter.

- b. Adhesive must meet the requirements of low emitting materials credit.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.
- B. Beginning of installation means acceptance of substrate.
- C. Coordinate gypsum board Work with Work specified in other Sections to properly locate framing members and to provide additional framing and backing as necessary for recessed and built-in components.
 - 1. Verify that framing and furring are securely attached and of sizes and spacing to provide a suitable substrate to receive gypsum board.
 - 2. Maintain a minimum temperature of 50 degrees F for a period extending from 48 hours before installation until the joint compounds have completely dried.
- D. Examine substrates which gypsum board wall construction attaches to or abuts, including the following.
 - 1. Preset hollow metal frames
 - 2. Piping.
 - 3. Conduit.
 - 4. Ductwork.
- E. Provide adequate and continuous ventilation to ensure proper drying, setting or curing of taping and finishing compounds. Provide temporary air circulators in enclosed areas lacking natural ventilation. GA-216, article 18.2.
- F. Provide fixtures, anchors, sleeves, inserts and miscellaneous items, and provide openings and chases as necessary. Prior to closing in and finishing of drywall Work, ascertain that piping, conduit, ductwork and fixtures which are to be concealed and which penetrate gypsum boards are in place, tested and approved.
- G. Scaffolding: Construct, erect and maintain in conformance with applicable laws and ordinances.
- H. Fire Protection: Where required, the Work shall comply with the requirements for the protection rating indicated in the governing building code.
- I. Fire Sprinkler System: In areas where sprinkler heads occur, exercise care when installing drywall work. Do not damage or obstruct the heads in any way.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

- A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.
- B. Sound Isolation Tape: Apply to vertical studs and top and bottom tracks/runners in accordance with manufacturer's instructions.
 - 1. Acoustic Tape: Place on top of all partition walls that do not project above suspended ceiling assemblies. Adhesive side shall be place on top of the wall.
- C. Acoustic Sealant: Install in accordance with manufacturer's instructions.
 - 1. Place one bead continuously on substrate before installation of perimeter framing members.

2. Place continuous bead at perimeter of each layer of gypsum board.
3. Seal around all penetrations by conduit, pipe, ducts, and rough-in boxes, except where firestopping is provided.

3.03 BOARD INSTALLATION

- A. Regulatory Requirements: Install gypsum board products in accordance with applicable Code requirements and requirements of listed assemblies shown on Drawings.
- B. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- C. Single-Layer Nonrated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
 1. Exception: Tapered edges to receive joint treatment at right angles to framing.
 2. In wood frame construction, erect panels horizontally only.
- D. Double-Layer, Nonrated: Use gypsum board for first layer, placed parallel to framing or furring members, with ends and edges occurring over firm bearing. Use glass mat faced gypsum board at exterior walls and at other locations as indicated. Place second layer perpendicular to framing or furring members. Offset joints of second layer from joints of first layer.
- E. Exposed Gypsum Board in Interior Wet Areas: Seal joints, cut edges, and holes with water-resistant sealant.
- F. Exterior Sheathing: Comply with ASTM C1280. Install sheathing vertically, with edges butted tight and ends occurring over firm bearing.
 1. Seal joints, cut edges, and holes with water-resistant sealant.
 2. Paper-Faced Sheathing: Immediately after installation, protect from weather by application of water-resistive barrier.
- G. Cementitious Backing Board: Install over wood framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.
- H. Fastener Spacing: Space fasteners in accordance with reference standards and fire rating requirements of wall, partition, floor and ceiling assembly. Maximum spacing of 1-inch screws 8 inches on centers at vertical edges and 12 inches on centers in field and at top and bottom.
- I. Installation on Wood Framing: For rated assemblies, comply with requirements of listing authority. For nonrated assemblies, install as follows:
 1. Single-Layer Applications: Screw attachment.
 2. Double-Layer Application: Install base layer using screws. Install face layer using screws or adhesive.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

- A. Use longest practical lengths. Place corner beads at external corners. Place edge trim when gypsum board abuts dissimilar materials. Surfaces indicated to receive non-textured finish and semi-gloss enamels.
- B. Control Joints: Place control joints consistent with lines of building spaces and as indicated.
 1. Not more than 30 feet apart on walls and ceilings.
 2. Maintain fire and sound rating at control joints.
- C. Corner Beads: Install at external corners, using longest practical lengths.

- D. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

3.05 JOINT TREATMENT

- A. Glass Mat Faced Gypsum Board and Exterior Glass Mat Faced Sheathing: Use fiberglass joint tape, embed and finish with setting type joint compound.
- B. Paper Faced Gypsum Board: Use paper joint tape, embed with drying type joint compound and finish with drying type joint compound.
- C. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
1. Level 5: Walls and ceilings to receive, eggshell, semi-gloss or gloss paint finish and other areas specifically indicated. (Including High-Gloss thin wallcovering.)
 2. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
 3. Level 3: Walls to receive textured wall finish or heavy textured paint.
 4. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
 5. Level 1: Wall areas above finished ceilings, whether or not accessible in the completed construction.
 6. Level 0: Temporary partitions.
- D. Tape, fill, and sand all exposed joints, edges, and corners, including inside corners to produce smooth surface ready to receive finishes.
1. Feather coats of joint compound so that camber is maximum 1/32 inch.
 2. Tape shall be set over joint and seated into joint compound, leaving sufficient adhesive under tape to provide proper bond.
 3. Internal angles, both horizontal and vertical, shall be reinforced and with tape folded to form straight and true angle.
 4. Metal external corners shall be cemented in place.
 5. Joints shall be allowed to dry according to Gypsum Association Standards based on temperature and humidity. Allow for at least 24 hours between each application of joint compound.
 6. The final application of compound and sanding shall leave all surfaces uniformly smooth and in condition to receive specified finish.
 7. Taping, filling, and sanding are not required at surfaces behind adhesive applied tile and fixed cabinetry.
 8. Taping, filling, and sanding are not required at base layer of double-layer applications.
- E. Where Level 5 finish is indicated, spray apply high build drywall surfacer over entire surface after joints have been properly treated; achieve a flat and tool mark-free finish.
- F. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

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

3.07 REPAIR, CLEAN-UP AND PROTECTION

- A. Repair damage to galvanized coatings in conformance with ASTM A780/A780M.

- B. Repair fastener pops by driving a new fastener approximately 1-1/2 inches from the fastener pop and reset the popped fastener. When face paper is punctured, install a new fastener approximately 1-1/2 inches from the defective fastener. Fill damaged surfaces with compound.
- C. 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.

3.08 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.

3.09 PROTECTION

- A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 09 22 36 LATH

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Metal lath for cement plaster.
- B. Furring for metal lath.
- C. Metal ceiling framing.

1.02 RELATED REQUIREMENTS

- A. Section 07 25 00 - Weather Barriers: Water-resistive barrier under exterior plaster and stucco.
- B. Section 08 31 00 - Access Doors and Panels: Product requirements for metal access panels integral with metal lath.
- C. Section 09 21 16 - Gypsum Board Assemblies: Sheathing on exterior walls.
- D. Section 09 24 00 - Cement Plastering.

1.03 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 A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- C. ASTM A924/A924M - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process; 2022a.
- D. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM C841 - Standard Specification for Installation of Interior Lathing and Furring; 2023.
- G. ASTM C847 - Standard Specification for Metal Lath; 2018.
- H. ASTM C933 - Standard Specification for Welded Wire Lath; 2023.
- I. ASTM C1032 - Standard Specification for Woven Wire Plaster Base; 2018.
- J. ASTM C1063 - Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster; 2023.
- K. CBC Sections 2504, 2507, and 2510.
- L. Plaster Assemblies Manual - Technical Information Services Bureau (TSIB) of Western Walls & Ceilings Contractors Association (WWCCA); Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on furring and lathing components, structural characteristics, material limitations, and finish.

1.05 QUALITY ASSURANCE

- A. Maintain one copy of each installation standard referenced on site throughout the duration of lathing and plastering work.
- B. Installer Qualifications: Company specializing in performing the work of this section with at least three years of documented experience.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Metal Lath and Accessories:
 - 1. Brand X Metals: www.brandxmetals.com.
 - 2. CEMCO: www.cemcosteel.com/#sle.
 - 3. ClarkDietrich: www.clarkdietrich.com/#sle.
 - 4. Stockton Products: www.stocktonproducts.com.
 - 5. Structa Wire Corporation; Structalath: www.structawire.com/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FRAMING AND LATH ASSEMBLIES

- A. Provide completed assemblies with the following characteristics: See also CBC Table 1604A.3.
 - 1. Maximum Deflection of Vertical Assemblies: 1:360 under lateral point load of 100 lbs.
 - 2. Maximum Deflection of Horizontal Assemblies: 1:240 deflection under dead loads and wind uplift.
- B. Fire Rated Assemblies: Provide components complying with requirements for fire rated assemblies specified in the section where the plaster finish is specified.

2.03 FRAMING MATERIALS

- A. Furring Channels: Formed steel, minimum 0.020 inch thick, 3/8 inch deep by 7/8 inch high, splicing permitted; galvanized.
- B. Main Ceiling Channels: Formed steel, asphalt coated, minimum 0.05 inch thick, 3/4 inch deep by 1-1/2 inch high, single piece, no splicing; galvanized.
- C. Hangers: Steel wire, of size and type to suit application, to support ceiling components in place to deflection limits as indicated.
- D. Ceiling Hangers: Rolled steel sections, of size and type to suit application, to rigidly support ceiling components in place to deflection limits as indicated; galvanized.
- E. Lateral Bracing: Formed steel, minimum 0.060 inch thick, size and length as required; galvanized.

2.04 LATH

- A. Diamond Mesh Metal Lath: ASTM C847, galvanized; self-furring.
 - 1. Weight: To suit application comply with deflection criteria and as specified in ASTM C841 or ASTM C1063 for framing spacing.
 - 2. Minimum Weight: 3.4 lb/sq yd.
- B. Ribbed Metal Lath: ASTM C847, galvanized; 3/8 inch thick. For soffit use only.

1. Weight: To suit application _____ and as specified in ASTM C841 or ASTM C1063 for framing spacing.
2. Minimum Weight: 3.4 lb/sq yd.
- C. Welded Wire Lath: ASTM C933; galvanized; with 2 inch square openings, paper strips woven into lath, of weight to suit application, comply with deflection criteria, and as specified in ASTM C841 or ASTM C1063 for framing spacing.
- D. Finishing Accessories: ASTM C841 (gypsum plaster) or ASTM C1063 (cement plaster); extruded aluminum alloy (6063 T5), galvanized steel sheet ASTM A924/A924M G90, or galvanized steel wire, unless noted otherwise.
 1. Types: As detailed or required for finished appearance.
 2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed plaster edges.
 3. Products:
 - a. Same manufacturer as framing materials.
 - b. Fry Reglet; Trim and Reveal Systems: www.fryreglet.com.
 - c. Pittcon Industries: www.pittconindustries.com.
 - d. Stockton Products; Extruded Aluminum: www.stocktonproducts.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Beads, Screeds, Joint Accessories, and Other Trim: Depth governed by plaster thickness, maximum possible lengths.
 1. Galvanized Steel Accessories:
 - a. Types specified below conforming to Technical Services Information Bureau of the Western Walls and Ceilings Contractors Association (WWCCA) "Plaster Assemblies Manual".
 - b. Where galvanized accessories are specified, use hot-dip galvanized steel, ASTM A653/A653M, designation G90/Z275, and bonderized.
 - c. Provide metal shapes, of longest possible length, used as grounds of such size and dimension as to provide for required plaster thickness.
 2. Material: Formed galvanized sheet steel, expanded metal flanges.
 3. Casing Beads with Weep Holes: Square edges.
 - a. Fabricated of 26 gauge, 0.0217 inch hot-dip galvanized steel and bonderized. Provide beads with expanded metal flange and inverted vee at plaster edge of face flange.
 - b. Provide weep holes only where indicated on drawings and in weeping conditions.
 - c. Products:
 - 1) CEMCO: #66 Expanded Flange Casing Bead: www.cemcosteel.com/#sle.
 - 2) Phillips Manufacturing Co; #66 Expanded Flange Square Casing Bead: www.phillipsmfg.com/#sle.
 - 3) Stockton Products; JB: J-Bead: www.stocktonproducts.com.
 - 4) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
 4. Corner Beads: Square-Edge corners.
 - a. Corner Reinforcement: Fabricated from expanded metal with large openings, from welded or woven copper bearing steel wire of minimum 28 gage, hot-dip galvanized, minimum 3 inches wide.

- b. Products:
 - 1) CEMCO; No. 2-A Corner Bead and ; No. 2-A Reinforced Flange Corner Bead: www.cemcosteel.com/#sle.
 - 2) Phillips Manufacturing Co; #1 Expanded Corner Bead: www.phillipsmfg.com/#sle.
 - 3) Stockton Products: www.stocktonproducts.com/#sle.
 - 4) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- 5. Corner Reinforcement: Fabricated from from welded or woven copper bearing steel wire of minimum 28 gage, hot-dip galvanized, minimum 3 inches wide.
 - a. Products:
 - 1) CEMCO; Cemcorner: www.cemcosteel.com/#sle.
 - 2) Stockton Products: www.stocktonproducts.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
- 6. Corner Reinforcement: Fabricated from expanded metal with large openings, from welded or woven copper bearing steel wire of minimum 28 gage, hot-dip galvanized, minimum 3 inches wide.
 - a. Cornerite: Expanded Metal, weighing 0.105 pounds per lineal foot, bent in center to form 105 degree angle, 6 inches wide (total).
 - 1) Product: Cornerite manufactured by Cemco.
- 7. Expansion Joints: Accordion profile with factory-installed protective tape, 2 inch wide flanges.
 - a. Basis of Design Product: Double "J" Control Joint (#XJ-15) manufactured by CEMCO.
 - b. Basis of Design Product at Horizontal Conditions: M-Slide Expansion Joint manufactured by CEMCO.
 - c. Stress Relief Joints (Expansion and Control Joints): Stress Relief Control Joints, fabricated of 28 gage (0.0187 inch) hot-dip galvanized steel.
 - d. Interior Corner Expansion Joints: 26 gage (0.0217 inch) hot-dip galvanized steel. Double V expansion joint formed to 90 degrees.
 - 1) Products:
 - (a) CEMCO; Corner Expansion Joint (#30): www.cemcosteel.com/#sle.
 - (b) Phillips Manufacturing Co; #15 Double V Expansion Joint: www.phillipsmfg.com/#sle.
 - (c) Stockton Products: www.stocktonproducts.com/#sle.
 - (d) Substitutions: See Section 01 60 00 - Product Requirements.
- 8. Base Screeds:
 - a. Material: Galvanized steel, ASTM A653/A653M, with G90/Z275 zinc coating; minimum 26-gauge, 0.0179-inch thick base metal.
 - b. Foundation Weep Screeds: Perforated type.
 - c. Products:
 - 1) Basis of Design Product: NFD: #5 Drip, with weep holes manufactured by Stockton Products.
 - 2) Basis of Design Product: No. 7 Extended Foundation Screed manufactured by CEMCO. For locations where plaster is just above a paving surface.

- 3) Stockton Products: www.stocktonproducts.com/#sle.
 - 4) Substitutions: See Section 01 60 00 - Product Requirements.
 9. Drip Screeds: Fabricated from 0.018 inch thick; G-90 hot-dip galvanized steel.
 - a. Product: NFD: #5 Drip manufactured by Stockton Products.
 - b. Product: #6 Head Drip Screed manufactured by CEMCO. For locations above other flashing such as door and window heads.
 10. Window/Door Drips: Self weeping 26 gage hot-dip galvanized steel.
 - a. Product: No. 3 Flashing Screed manufactured by CEMCO. For locations where plaster is offset 1-1/2 inches back from projection.
 11. Strip Lath: Strip Reinforcement (Expanded Metal), weighing 2.5 lbs/sq.yd., 6 inches wide. Use hot-dip galvanized at all locations where galvanized metal lath occurs.
 12. Control Joints: Accordion profile with factory-installed protective tape, 2 inch flanges.
 - a. Product: Double "V" Control Joint (#15) manufactured by CEMCO.
 - b. Stress Relief Joints (Expansion and Control Joints): Stress Relief Control Joints, fabricated of 26 gage (0.0217 inch) hot-dip galvanized steel with G60 hot-dip galvanized coating.
 - 1) Recesses on control joints shall be covered with removable tape or filled with rope to prevent plaster from filling the recess.
- F. Aluminum Accessories (Where Detailed):
1. Specified Manufacturer: Fry Reglet Corporation; www.fryreglet.com.
 2. Acceptable Manufacturers:
 - a. Interior Specialties Division, Gordon, Inc.; www.gordon-inc.com.
 - b. Stockton Products; Extruded Aluminum: www.stocktonproducts.com/#sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 3. Do not allow base aluminum to contact cementitious materials.
 4. Casing Beads: Fry Reglet, F-shaped aluminum, FPM-75-75, 3/4 inch reveal or Fry J-Molding JPM-75 as detailed.
 5. Control Joints: Fry Reglet, Channel Screed, PCS-75-50, 1/2 inch wide reveal or as detailed on Drawings.
 6. All intersections factory fabricated with joints heliarc welded and backs sealed with permanent waterproof tape. Provide connector clips and sealant at butt joints of straight sections.
 7. Soffit Vent:
 - a. Material: Extruded Aluminum ASTM B221 (ASTM B221M), 6063 alloy, T5 temper.
 - b. Size: As indicated on Drawings.
 - c. Finish: Clear Anodized.
 - d. Products:
 - 1) Basis of Design Product: Soffit Vent PCS-75-V-400 (example for 4 inch size with 3-coat plaster) manufactured by Fry Reglet.
 - 2) Stockton Products: www.stocktonproducts.com/#sle.
 - 3) Substitutions: See Section 01 60 00 - Product Requirements.
 8. Aluminum Finish:

- a. Clear anodized.
- 9. Fasteners: 1-1/4 inch long S-12 pancake head, USG, Buildex Division of Illinois Tool Works or equal.

2.05 ACCESSORIES

- A. Access Panels: See Section 08 31 00.
- B. Anchorage: Tie wire, nails, and other metal supports, of type and size to suit application; to rigidly secure materials in place, galvanized per ASTM C1063.
 - 1. At Horizontal Soffit Surfaces: Comply with CBC 2507.3 (DSA).
 - a. Staples (for wood): Zinc plated, 9 gage, ring shank, hook type, 3/4 inch crown, 2 inch leg.
 - b. Tie Wire: 18 gage, double strand.
- C. Tie Wire: Annealed galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that substrates are ready to receive work and conditions are suitable for application.
- C. For exterior plaster and stucco on stud walls, verify that water-resistive barrier has been installed over sheathing substrate completely and correctly; see Section 07 25 00.
 - 1. Do not allow the control or expansion joints to interrupt or be lapped with the weather barrier.
- D. Do not begin until unacceptable conditions have been corrected.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.02 INSTALLATION - GENERAL

- A. Install interior lath and furring for gypsum plaster in accordance with ASTM C841.
- B. Install metal lath and furring for Portland cement plaster in accordance with ASTM C1063.
- C. Install lath and furring for fire-rated assemblies in accordance with requirements of assembly as indicated.

3.03 CEILING AND SOFFIT FRAMING INSTALLATION

- A. Install furring after work above ceiling or soffit is complete. Coordinate the location of hangers with other work.
- B. Install furring independent of walls, columns, and above-ceiling work.
- C. Securely anchor hangers to structural members or embed in structural slab. Space hangers as required to limit deflection to criteria indicated. Use rigid hangers at exterior soffits.
- D. Space main carrying channels at maximum 72 inch on center, and not more than 6 inches from wall surfaces. Lap splice securely.
- E. Securely fix carrying channels to hangers to prevent turning or twisting and to transmit full load to hangers.
- F. Install furring channels perpendicular to carrying channels, not more than 2 inches from perimeter walls, and rigidly secure. Lap splices securely.

- G. Reinforce openings in suspension system that interrupt main carrying channels or furring channels with lateral channel bracing. Extend bracing minimum 24 inches past each opening.
- H. Laterally brace suspension system.

3.04 CONTROL AND EXPANSION JOINT INSTALLATION

- A. At unsheathed open framing, provide double stud construction behind control joint.
- B. Locate joints as indicated on drawings and comply with ASTM C1063.
 - 1. Area of plaster panel not to exceed 144 sq ft for vertical surfaces.
 - a. Expansion Joint Spacing: 36 feet maximum on center and as indicated on drawings.
 - 2. Area of plaster panel not to exceed 100 sq ft for horizontal, curved or angled surfaces.
 - 3. Spacing between control joints not to exceed 18 ft in each direction.
 - a. Narrow panels should not exceed 12 feet in length.
 - 4. Area bounded by control joints not to exceed a length-to-width ratio of 2-1/2 to 1.
 - 5. Vertical control joints should pass through horizontal control joints. Vertical control joints must terminate at horizontal expansion joints.
 - 6. Joint Placement: Approved by Architect before plastering.
- C. Install expansion joints where an expansion joint occurs in base exterior wall.
- D. Install prefabricated joint accessories in accordance with ASTM C1063.
 - 1. Install factory-made joints at reveal-to-reveal and reveal-to-control joint intersections.
- E. Discontinue metal lath at joint and apply 12 inch wide strip of flexible flashing behind each joint
- F. Hold casing beads back 3/8 to 1/4 inch from abutting frames and other elements to provide joint for sealant.
- G. Apply sealant at splices, intersections and terminals in accordance with Section 07 92 00 - Joint Sealants.

3.05 ACCESS PANELS INSTALLATION

- A. Install access panels and rigidly secure in place.
- B. Install frames plumb and level in opening. Secure rigidly in place.
- C. Position to provide convenient access to concealed work requiring access.

3.06 LATH INSTALLATION

- A. Apply lath taut, with long dimension perpendicular to supports.
- B. Lap or nest ends of metal lath in accordance with ASTM C841.
- C. Secure end laps with tie wire where they occur between supports.
- D. Do not continue lath through control or expansion joints.
- E. Apply ribbed lath with self-furring ribs perpendicular to supports at soffits and horizontal surfaces.
 - 1. Lap sides of ribbed lath minimum 1-1/2 inches.
 - 2. Nest outside ribs of rib lath together.
 - 3. Attach lath to supports using specified screws at maximum 6 inches on center vertical and 16 inches on center horizontal.
 - 4. At horizontal metal lath application, secure lath to each support with specified screws.

- F. Expanded metal lath at vertical supports, apply self-furring “grooved” metal lath with self-furring rib perpendicular to supports.
 - 1. Install per Table 2507.2 California Building Code.
 - 2. Maintain lath 1/4 inch away from vertical supports.
- G. Attach metal lath to supports using screws at maximum 12 inches on center.
- H. Attach horizontal metal lath to metal supports using tie wire at maximum 6 inches on center vertical.
- I. Attach non-metallic lath to metal supports using manufacturers recommended fasteners at maximum 7 inches on center.
- J. Continuously reinforce internal angles with corner mesh, except where the metal lath returns 3 inches from corner to form the angle reinforcement; fasten at perimeter edges only.
- K. Place corner bead with mesh at external wall corners; fasten at outer edges of lath only.
- L. Place strip lath diagonally at corners of lathed openings. Secure rigidly in place.
- M. Place strip lath centered over junctions of dissimilar backing materials on same plane. Secure rigidly in place.
- N. Place base screeds at termination of plaster areas; secure rigidly in place.
 - 1. Install weep screeds at foundation. Install minimum 4 inches above earth or 2 inches above paved areas.
 - 2. To allow moisture to escape from a portland cement plaster (stucco) assembly, no sealant shall be placed at the bottom of the plaster termination.
- O. Place 4 inch wide strips of lath centered over junctions of dissimilar backing materials, and secure rigidly in place.
- P. Place lath vertically above each top corner and each side of door frames to 6 inches above ceiling line.
- Q. Place casing beads at terminations of plaster finish. Butt and align ends, cope or miter at corners. Secure rigidly in place, maximum 12 inches on centers..
- R. Place additional strip mesh diagonally at corners of lathed openings. Secure rigidly in place.

3.07 FIELD QUALITY CONTROL

- A. Inspection: Notify Architect minimum 2 days prior to scratch coat for inspection of all in-place lath and accessories.

3.08 TOLERANCES

- A. Install accessories to lines and levels.
- B. Maximum Variation from True Lines and Levels: 1/8 inch in 10 feet.
- C. Maximum Variation from True Position: 1/8 inch.

END OF SECTION

SECTION 09 24 00 CEMENT PLASTERING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Cement plastering.

1.02 RELATED REQUIREMENTS

- A. Section 08 31 00 - Access Doors and Panels: Access panels.
- B. Section 09 21 16 - Gypsum Board Assemblies: Gypsum Sheathing: Solid backing at all exterior plaster.
- C. Section 09 22 36 - Lath: Lath, furring, beads, screeds, and joint accessories for plaster base.
- D. Section 09 91 13 - Exterior Painting: Finish paint over integral color plaster.

1.03 REFERENCE STANDARDS

- A. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- B. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes; 2018.
- C. ASTM C926 - Standard Specification for Application of Portland Cement-Based Plaster; 2023a.
- D. ASTM C932 - Standard Specification for Surface-Applied Bonding Compounds for Exterior Plastering; 2006 (Reapproved 2019).
- E. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- F. CBC - California Building Code; Current Adopted Edition.
- G. TSIB (PAM) - Plaster Assemblies Manual, Technical Services Information Bureau; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittals procedures.
- B. Product Data: Provide data on plaster materials and trim accessories.
- C. Samples:
 - 1. Submit two samples, 8 by 8 inch in size illustrating finish color and texture.
 - 2. Submit two samples of each type trim accessory.
- D. Evaluation Service Reports: Show compliance with specified requirements.
- E. Installer's Qualification Statement.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience.
- B. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.06 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Mock-Up Panel: Construct a 4 foot wide by 8 foot high sample panel of plaster work at the jobsite demonstrating installation procedures, finish texture, and color. Show each phase of installation including framing and reinforcement.
- C. After color and texture samples have been approved and returned, construct a mock-up not less than as noted above in size, of each texture type, in location approved by Architect.
 - 1. Use workmen, equipment and techniques proposed for use on the project.
 - 2. The panel may be constructed as a portion of the finished work, provided the approved panel is clearly identified for future reference.
 - 3. The approved panel shall become the standard of comparison for cement plaster work for the project.
 - 4. If mock-up is not a part of building construction, it must be removed when directed by Architect after completion of project.

1.07 FIELD CONDITIONS

- A. Exterior Plaster Work: Do not apply plaster when substrate or ambient air temperature is 40 degrees F or lower, or when temperature is expected to drop below 40 degrees F within 48 hours of application.

PART 2 PRODUCTS

2.01 CEMENT PLASTER APPLICATIONS

- A. Lath Plaster Base: Metal lath.
 - 1. Plaster Type: Factory prepared plaster mix.
 - 2. Number of Coats: Three.
 - 3. First Coat: Apply to a nominal thickness of 3/8 inch.
 - 4. Second Coat: Apply to a nominal thickness of 3/8 inch.
 - 5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
 - 6. Finish: Acrylic.
- B. Solid Plaster Base: Concrete masonry.
 - 1. Plaster Type: Factory prepared plaster mix.
 - 2. Number of Coats: One.
 - 3. First Coat: Apply to a nominal thickness of 1/4 inch.
 - 4. Second Coat: Apply to a nominal thickness of 1/4 inch.
 - 5. Leveling Coat: Apply to a nominal thickness of 1/32 to 1/16 inch.
 - 6. Finish: Acrylic.

2.02 FACTORY PREPARED CEMENT PLASTER

- A. Fire-Resistance Rating: Determined in accordance with test procedures in ASTM E119 and complying with the following:
 - 1. CBC, Section 2504.2.1 Wood furring strips (DSA & OSHPD 1& 4), 2510 Lathing and Plastering, 2511 Interior Plaster, and 2512 Exterior Plaster.

- B. Exterior Portland cement plaster system made of scratch and brown base coat, leveling coat with reinforcing mesh, and acrylic finish coat; install in accordance with ASTM C926.
 - 1. Provide continuous exterior insulation, with drainage grooves, as part of the system, by the same manufacturer.
 - a. See Technical Bulletin 60.110, TSIB (PAM).
 - 2. Provide weather resistive barrier as part of the system.
 - 3. Manufacturer - Basis of Design:
 - a. Omega Products International, Inc.; Super Cement with Crack Isolation System: omega-products.com.
 - 4. Other Acceptable Manufacturers:
 - a. Dryvit; Commercial Cement Plaster (CCP) 4: www.dryvit.com.
 - b. LaHabra; FastWall 300: www.lahabrastucco.com/#sle.
 - c. Omega Products International, Inc.; Super Cement with Crack Isolation System: omega-products.com.
 - d. Parex USA, Inc; Armourwall 300: www.parexusa.com/#sle.
 - e. Sto Corp; Sto Powerwall: www.stocorp.com/#sle.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Premixed One-Coat Base: Mixture of Type I Portland cement complying with ASTM C150/C150M, hydrated lime complying with ASTM C207, fibers and other approved ingredients; install in accordance with ASTM C926.
 - 1. Manufacturers:
 - a. Omega Products International, Inc.; Diamond Wall Insulating One Coat System: omega-products.com.
- D. Premixed Base Coats: Mixture of cement, aggregate, fibers, and proprietary admixtures for scratch and brown coats; install in accordance with ASTM C926.
- E. Premixed Leveling Coat: Acrylic polymer-based blend approved for use with plaster manufacturer's base coat and finish materials.
- F. Painted Finish Coating: See Section 09 91 13.
- G. Primer: Acrylic, as recommended by coating manufacturer and compatible with plaster base coat.
- H. Premixed Textured Coating: Polymer modified acrylic coating, integrally colored, and trowel applied to substrates prepared in accordance with manufacturer's written installation instructions.
 - 1. Color: As indicated on drawings.

2.03 ACCESSORIES

- A. Lath: See Section 09 22 36.
- B. Finishing Accessories: See Section 09 22 36.
- C. Bonding Compound: Provide type recommended for bonding plaster to solid surfaces, complying with ASTM C932.
- D. Reinforcing Mesh: 4.5 oz/sq yd alkali-resistant mesh.
- E. Water-Resistive Barrier: See Section 07 25 00.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions are acceptable prior to starting this work.
- B. Verify lath is flat, secured to substrate, and joint and surface perimeter accessories are properly in place.
- C. Verify mechanical and electrical equipment and services located within areas to receive this work have been properly tested and approved.

3.02 PREPARATION

- A. Roughen smooth concrete surfaces and apply bonding compound in accordance with manufacturer's written installation instructions.

3.03 MIXING

- A. Mix only as much plaster as can be used prior to initial set.
- B. Mix materials dry, to uniform color and consistency, before adding water.
- C. Protect mixtures from frost or freezing temperatures, contamination, and excessive evaporation.

3.04 APPLICATION

- A. Apply plaster in accordance with manufacturer's written instructions and comply with ASTM C926.
- B. Base Coats:
 - 1. Apply base coat(s) to fully embed lath and to specified thickness.
 - 2. Follow guidelines in ASTM C926 and manufacturer's written installation instructions for moist curing base coats and application of subsequent coats.
- C. Leveling Coat:
 - 1. Apply leveling coat to specified thickness.
 - 2. Fully embed reinforcing mesh in leveling coat.
- D. Finish Coats:
 - 1. Cement Plaster:
 - a. Apply with sufficient material and pressure to ensure complete coverage of base to specified thickness.
 - b. Apply desired surface texture while mix is still workable.
 - c. Float to a consistent finish.
 - 2. Primer and Acrylic Coatings:
 - a. Remove surface contaminants such as dust and dirt without damaging substrate.
 - b. Apply primer in accordance with manufacturer's instructions.
 - c. Apply finish coating in number of coats and to thickness recommended by manufacturer.
 - 3. Acrylic Finish Texture: Apply to a consistent finish.
 - a. TSIB (PAM) Fine Sand.
- E. Finish Painting Overcoat: See Section 09 91 13 - Exterior Painting.

3.05 TOLERANCES

- A. Maximum Variation from True Flatness: 1/4 inch in 10 feet.

3.06 REPAIR

- A. Patching: Remove loose, damaged or defective plaster and replace with plaster of same composition; finish to match surrounding area.

END OF SECTION

SECTION 09 30 00 TILING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tile for floor applications. TF-1.
- B. Tile for wall applications. TW-1 & TW-2.
- C. Cementitious backer board as tile substrate.
- D. Stone thresholds.
- E. Ceramic trim. TB-1
- F. Non-ceramic trim. TR-1, TR-2, MTB-1, & MTB-2.

1.02 RELATED REQUIREMENTS

- A. Section 07 92 00 - Joint Sealants: Sealing joints between tile work and adjacent construction and fixtures.
- B. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI A108/A118/A136 - American National Standard Specifications for the Installation of Ceramic Tile (Compendium).
- C. ANSI A108.10 - American National Standard Specifications for Installation of Grout in Tilework.
- D. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units.
- E. ANSI A118.3 - American National Standard Specifications for Chemical Resistant, Water Cleanable Tile-Setting and -Grouting Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.
- F. ANSI A118.4 - American National Standard Specifications for Modified Dry-Set Cement Mortar.
- G. ANSI A118.7 - American National Standard Specifications for High Performance Cement Grouts for Tile Installation.
- H. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units.
- I. ANSI A118.10 - American National Standard Specifications for Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimension Stone.
- J. ANSI A118.12 - American National Standard Specifications for Crack Isolation Membranes for Thin-Set Ceramic Tile and Dimension Stone Installation.
- K. ANSI A118.15 - American National Standard Specifications for Improved Modified Dry-Set Cement Mortar.

- L. ANSI A136.1 - American National Standard Specifications for Organic Adhesives for Installation of Ceramic Tile.
- M. ANSI A137.1 - American National Standard Specifications for Ceramic Tile.
- N. ANSI/NFSI B101.3 - Test Method for Measuring Wet DCOF of Common Hard Surface Floor Materials.
- O. ASTM C373 - Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products.
- P. ASTM C847 - Standard Specification for Metal Lath.
- Q. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
- R. BAAQMD 8-51 - Bay Area Air Quality Management District Regulation 8, Rule 51, Adhesive and Sealant Products.
- S. SCAQMD 1168 - Adhesive and Sealant Applications.
- T. TCNA (HB) - Handbook for Ceramic, Glass, and Stone Tile Installation.
- U. TCNA (HB-GP) - Handbook for Gauged Porcelain Tiles and Gauged Porcelain Tile Panels/Slabs Installation.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting one week before starting work of this section; require attendance by affected installers.
 - 1. Discussion topics: dry times, cure times, protection of all steps of tile installation system (membranes, adhesive, grout).

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide manufacturers' data sheets on tile, mortar, grout, and accessories. Include instructions for using grouts and adhesives.
- C. Shop Drawings: Indicate tile layout, patterns, color arrangement, perimeter conditions, junctions with dissimilar materials, control and expansion joints, thresholds, and setting details.
- D. Samples: Mount tile and apply grout on two plywood panels, minimum 18 by 18 inches in size illustrating pattern, color variations, and grout joint size variations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Master Grade Certificate: Submit for each type of tile, signed by the tile manufacturer and tile installer.
 - 1. Prior to shipment of tile to jobsite, deliver Master Grade Certificates to Architect, complying with TCNA/ANSI A137.1.
- G. Installer's Qualification Statement:
 - 1. Submit documentation of National Tile Contractors Association (NTCA) or Tile Contractors' Association of America (TCAA) accreditation.
 - 2. Submit documentation of completion of apprenticeship and certification programs.
- H. Maintenance Data: Include recommended cleaning methods, cleaning materials, and stain removal methods.
- I. Maintenance Materials: Furnish the following for District's use in maintenance of project.

1. See Section 01 60 00 - Product Requirements, for additional provisions.
2. Extra Tile: One box, minimum of 24 pieces of each size, color, and surface finish combination.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of ANSI A108/A118/A136, TCNA (HB), and TCNA (HB-GP) on-site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section, with minimum five years of documented experience.
- C. Installer Qualifications:
 1. Company specializing in performing tile installation, with minimum of five years of documented experience.
 2. Installer Certification:
 - a. Ceramic Tile Education Foundation (CTEF): Certified Tile Installer (CTI).
 - b. Apprenticeship Program: Installer has achieved Journeyworker status through an apprenticeship from the International Union of Bricklayers and Allied Craftworkers (IUBAC) or a U.S. Department of Labor (DOL)-recognized program.
 - c. Advanced Certifications for Tile Installers (ACT): Certification in the installation of membranes, mortar bed (mud) floors, mortar (mud) walls, large format tile, gauged porcelain tile/panels/slabs, and grouts.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for general requirements for mock-up.
- B. Construct tile mock-up where indicated on drawings, incorporating all components specified for the location.
 1. Minimum size of mock-up is indicated on drawings.
 2. Approved mock-up may remain as part of work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Protect adhesives from freezing or overheating in accordance with manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Do not install solvent-based products in an unventilated environment.
- B. Maintain ambient and substrate temperature above 50 degrees F and below 100 degrees F during installation and curing of setting materials.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Requirements for Persons with Disabilities: Provide ceramic tile flooring meeting slip-resistant requirements of California Code of Regulations (CCR), Title 24, Part 2, Chapter 11B and ADA Standards, latest amendment.
 1. Tile flooring surface shall be stable, firm, and slip resistant. CBC Section 11B-302.1 General.

2. Tile flooring Surface shall demonstrate a dynamic coefficient of friction of at least 0.42 wet per DCOF AcuTest ANSI A137.1 Section 9.6 and ANSI/NFSI B101.3(using a BOT-3000 testing unit) will be accepted as meeting the intent of slip resistance; CBC 11B-302 Floor or Ground Surfaces and ADA Standards.
 - a. Ramp surface: Provide wet DCOF value of 0.46.
- B. California Plumbing Code:
 1. Floor Drains:
 - a. Inspection of Work - All surfaces prepared by others shall be inspected by the tile installer before starting tile work and all unsatisfactory conditions reported to the Administrative Authority. Starting tile work by the tile installer shall be considered as acceptance of surfaces prepared by others.
 - b. Surfaces - All surfaces to receive tile work shall be clean, structurally sound, and slopes shall conform to CBC.

Note: No tile work shall proceed until the pan and drain construction has been inspected and approved by the Administrative Authority, where required.
 2. Definition:
 - a. Receptor: An approved plumbing fixture or device of such material, shape, and capacity as to adequately receive the discharge from indirect waste pipes, so constructed and located as to be readily cleaned. CPC 220.0

2.02 TILE

- A. Manufacturers:
 1. American Olean Corporation: www.americanolean.com/#sle.
 2. Crossville, Inc. : www.crossvilleinc.com.
 3. Dal-Tile Corporation: www.daltile.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Porcelain Tile: ANSI A137.1 standard grade.
 1. Moisture Absorption: 0 to 0.5 percent as tested in accordance with ASTM C373.
 2. Size: as indicated on Drawings, nominal.
 3. Thickness: 3/8 inch.
 4. Edges: Interlocking shape.
 5. Surface Finish: Unglazed.
 - a. Dynamic Wet Slip Resistance DCOF AcuTest: 0.42
 6. Color(s): To be selected by Architect from manufacturer's standard range.
 7. Trim Units: Matching bullnose, cove base, and cove shapes in sizes coordinated with field tile.

2.03 TRIM AND ACCESSORIES

- A. Ceramic Trim: Matching bullnose, double bullnose, cove base, and cove ceramic shapes in sizes coordinated with field tile.
 1. Applications:
 - a. Open Edges: Bullnose.

- b. Inside Corners: Jointed.
 - c. Floor to Wall Joints: Cove base. TB-1
 - 2. Manufacturers: Same as for tile.
- B. Non-Ceramic Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
 - 1. Applications:
 - a. Open edges of wall and floor tile. TR-1 & TR-2.
 - b. Floor-to-wall joints. MTB-1 & MTB-2.
 - 1) Aluminum: Schuler - DILEX-AHK.
 - c. Borders and other trim as indicated on drawings.
 - 2. Products:
 - a. Blanke Corporation; Blanke - Trims and Profiles: www.blankecorp.com/#sle.
 - 1) Local Representative: Rick Coury, Tile Industry Sales, Inc. coury@earthlink.net; 714.915.1995.
 - b. Genesis APS International: www.genesis-aps.com/#sle.
 - c. LATICRETE International, Inc: www.laticrete.com/#sle.
 - d. Schluter-Systems: www.schluter.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Thresholds: 2 inches wide by full width of wall or frame opening; beveled edge on both long edges; without holes, cracks, or open seams.
 - 1. Thickness: 1/2 inch.
 - 2. Material: Solid surface acrylic resin, mineral filler, and pigments; non-porous, color and pattern consistent throughout thickness.
 - a. Solid Polymer Fabricated: ASTM D638.
 - b. Color and Pattern: As indicated on drawings.
 - 3. Material: Artificial stone tile; 93 percent quartz aggregate, resin, color pigments.
 - 4. Color and Pattern: As indicated on drawings.
 - 5. Applications:
 - a. At doorways where tile terminates.

2.04 SETTING MATERIALS

- A. Provide setting and grout materials from same manufacturer.
- B. Interior adhesives, sealants, primers and sealants used as filler must meet the requirements of low emitting materials. Conform to SCAQMD 1168 and BAAQMD 8-51.
- C. Manufacturers:
 - 1. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - 2. Custom Building Products: www.custombuildingproducts.com/#sle.
 - 3. H.B. Fuller Construction Products, Inc: www.tecspecialty.com/#sle.
 - 4. LATICRETE International, Inc: www.laticrete.com/#sle.
 - 5. Mapei Corporation: www.mapei.com/#sle.

6. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - a. Local Representative: Rick Coury, Tile Industry Sales, Inc. coury@earthlink.net; 714.915.1995.
 7. Sika Corp: www.sika.com/#sle.
 8. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Latex-Portland Cement Mortar Bond Coat: ANSI A118.4.
1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 2. Products:
 - a. ARDEX Engineered Cements; ARDEX X 5: www.ardexamericas.com/#sle.
 - b. Custom Building Products; ProLite Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; TRI-LITE: www.laticrete.com/#sle.
 - d. Mapei Corporation; Adesilex P10 Mosaic & Glass Tile: www.mapei.com/#sle.
 - e. Merkrete, by Parex USA, Inc; Merkrete 735 Premium Flex: www.merkrete.com/#sle.
 - f. Sika Corp; SikaTile 500 LHT: www.sika.com/#sle.
- E. Improved Latex-Portland Cement Mortar Bond Coat: ANSI A118.15.
1. Applications: Use this type of bond coat where Large and Heavy Tile (LHT) mortar is indicated.
 2. Products:
 - a. ARDEX Engineered Cements; S 28: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Complete Contact-LFT Premium Rapid Setting Large Format Tile Mortar, with Multi-Surface Bonding Primer: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; MULTIMAX LITE: www.laticrete.com/#sle.
 - d. Mapei Corporation; Ultraflex LFT: www.mapei.com/#sle.
 - e. Merkrete, by Parex USA, Inc: www.merkrete.com/#sle.
 - f. Sika Corp; SikaTile 450 LHT Secure Set: www.sika.com/#sle.
 - g. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- F. Epoxy Adhesive and Mortar Bond Coat: ANSI A118.3.
1. Applications: Where indicated on drawings.
 2. Products:
 - a. Custom Building Products; EBM-Lite Epoxy Bonding Mortar: www.custombuildingproducts.com/#sle.
 - b. LATICRETE International, Inc; LATICRETE LATAPOXY 300 Adhesive: www.laticrete.com/#sle.
 - c. Mapei Corporation; Kerapoxy 410: www.mapei.com/#sle.
 - d. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
 - e. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.

- f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- G. Organic Adhesive: ANSI A136.1, thinset mastic type.
 - 1. Use Type I in areas subject to prolonged moisture exposure.
 - 2. Products:
 - a. ARDEX Engineered Cements; ARDEX D14: www.ardexamericas.com/#sle.
 - b. Custom Building Products; ReliaBond Ceramic Tile Adhesive - Type 1: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE 15 Premium Mastic: www.laticrete.com/#sle.
 - d. MAPEI Corporation; Type 1: www.mapei.com/#sle.
 - e. Merkrete, by Parex USA, Inc; Merkrete Pro Mastic 400: www.merkrete.com/#sle.
 - f. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.05 GROUTS

- A. Provide setting and grout materials from same manufacturer.
- B. Manufacturers:
 - 1. Basis of Design: Custom Building Products: www.custombuildingproducts.com/#sle.
 - 2. ARDEX Engineered Cements: www.ardexamericas.com/#sle.
 - 3. Bonsal American, Inc; ProSpec Sanded Tile Grout 700: www.prospec.com
 - 4. LATICRETE International, Inc: www.laticrete.com/#sle.
 - 5. Mapei Corporation: www.mapei.com/#sle.
 - 6. Merkrete, by Parex USA, Inc; Merkrete Duracolor Non-Sanded Color Grout: www.merkrete.com/#sle.
 - 7. Sika Corp; SikaTile 800 Sanded/UnSanded Grout: www.sika.com/#sle.
 - 8. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. High Performance Polymer Modified Grout: ANSI A118.7 polymer modified cement grout.
 - 1. Applications: Use this type of grout where indicated on exterior over plaster.
 - 2. Use sanded grout for joints 1/8 inch wide and larger; use unsanded grout for joints less than 1/8 inch wide.
 - 3. Color(s): As selected by Architect from manufacturer's full line.
 - 4. Products:
 - a. Basis of Design: Custom Building Products; Fusion Pro Single Component Grout: www.custombuildingproducts.com/#sle.
 - b. ARDEX Engineered Cements; ARDEX FL: www.ardexamericas.com/#sle.
 - c. Custom Building Products; Prism Color Consistent Grout: www.custombuildingproducts.com/#sle.
 - d. LATICRETE International, Inc; LATICRETE PERMACOLOR Grout: www.laticrete.com/#sle.
 - e. Mapei Corporation; Ultracolor Plus FA: www.mapei.com/#sle.
 - f. Merkrete, by Parex USA, Inc; Merkrete Pro Grout Plus: www.merkrete.com/#sle.

- g. Sika Corp; SikaTile Secure Grout: www.sika.com/#sle.
 - h. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Epoxy Grout: ANSI A118.3 chemical resistant and water-cleanable epoxy grout.
 - 1. Applications: Toilet room floors.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX WA: www.ardexamericas.com/#sle.
 - b. Basis of Design: Custom Building Products; CEG-Lite 100% Solids Commercial Epoxy Grout: www.custombuildingproducts.com/#sle.
 - c. H.B. Fuller Construction Products, Inc; TEC AccuColor EFX Epoxy Special Effects Grout: www.tecspecialty.com/#sle.
 - d. LATICRETE International, Inc; LATICRETE SPECTRALOCK PRO Premium Grout: www.laticrete.com/#sle.
 - e. MAPEI Corporation; Kerapoxy Epoxy Grout: www.mapei.com.
 - f. Merkrete, by Parex USA, Inc; Merkrete Pro Epoxy: www.merkrete.com/#sle.
 - g. Sika Corp; SikaTile 825 Epoxy: www.sika.com/#sle.
 - h. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- E. Stain Resistant Grout Additive: Liquid admixture for sanded and unsanded cement-based grouts; mix with dry grout material in place of water.
 - 1. Applications: Toilet room floors.

2.06 MAINTENANCE MATERIALS

- A. Tile Sealant: Gunnable, silicone, siliconized acrylic, or urethane sealant; moisture and mildew resistant type.
 - 1. Applications: Between tile and plumbing fixtures.
 - 2. Color(s): As selected by Architect from manufacturer's full line.
 - 3. Products:
 - a. ARDEX Engineered Cements; ARDEX SX: www.ardexamericas.com/#sle.
 - b. Custom Building Products; Commercial 100% Silicone Caulk: www.custombuildingproducts.com/#sle.
 - c. LATICRETE International, Inc; LATICRETE LATASIL: www.laticrete.com/#sle.
 - d. Mapei Corporation; Mapesil T Plus: www.mapei.com/#sle.
 - e. Merkrete, by Parex USA, Inc; Merkrete MK-100SC 100% Silicone Caulk: www.merkrete.com/#sle.
 - f. Sika Corp; Sikasil N Plus: www.sika.com/#sle.
 - g. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Grout Sealer: Liquid-applied, moisture and stain protection for existing or new Portland cement grout.
 - 1. Composition: Water-based colorless silicone.
 - 2. Products:

- a. Specified Manufacturer: Aqua-Mix: www.custombuildingproducts.com; local representative Dale Roberts (951) 255-0243.
 - b. MAPEI Corporation; UltraCare Grout Sealer: www.mapei.com.
 - c. Merkrete, by Parex USA, Inc; Merkrete Revive: www.merkrete.com/#sle.
 - d. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Tile Sealer: Stain protection for ceramic tile and natural stone tile.
- 1. Products:
 - a. Custom Building Products; Aqua Mix Enrich 'N' Seal: www.custombuildingproducts.com/#sle.
 - b. MAPEI Corporation; UltraCare Enhancing Plus Stone Sealer: www.mapei.com.
 - c. Rust-Oleum Corporation; Miracle Sealants 511 Impregnator Natural Looking Penetrating Sealer: www.rustoleum.com/#sle.
 - d. STONETECH, a Division of LATICRETE International, Inc; STONETECH BulletProof Stone Sealer: www.laticrete.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- D. Grout Release: Temporary, water-soluble pre-grout coating.
- 1. Products:
 - a. Custom Building Products; Aqua Mix Grout Release: www.custombuildingproducts.com/#sle.
 - b. MAPEI Corporation; UltraCare Grout Release: www.mapei.com.
 - c. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.07 ACCESSORY MATERIALS

- A. Concrete Floor Slab Crack Isolation Membrane: Material complying with ANSI A118.12; not intended as waterproofing.
- 1. Crack Resistance: No failure at 1/8 inch gap, minimum.
 - 2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 20 mils, maximum.
 - c. Products:
 - 1) Custom Building Products; Custom 9240 Waterproofing and Anti-Fracture Membrane: www.custombuildingproducts.com.
 - 2) LATICRETE International, Inc; LATICRETE FRACTURE BAN SC: www.laticrete.com/#sle.
 - 3) Mapei Corporation; Mapelastic CI: www.mapei.com/#sle.
 - 4) Merkrete, by Parex USA, Inc; Merkrete Fracture Guard: www.merkrete.com/#sle.
 - 5) Sika Corp; SikaTile 200 Fracture Guard Rapid: www.sika.com/#sle.
 - 6) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- B. Waterproofing Membrane at Floors: Specifically designed for bonding to cementitious substrate under thick mortar bed or thin-set tile; complying with ANSI A118.10.

1. Crack Resistance: No failure at 1/16 inch gap, minimum; comply with ANSI A118.12.
2. Fluid or Trowel Applied Type:
 - a. Material: Synthetic rubber or Acrylic.
 - b. Thickness: 25 mils, minimum, dry film thickness.
 - c. Products:
 - 1) ARDEX Engineered Cements; ARDEX 8+9: www.ardexamericas.com/#sle.
 - 2) Custom Building Products; RedGard Crack Prevention and Waterproofing Membrane: www.custombuildingproducts.com/#sle.
 - 3) LATICRETE International, Inc; LATICRETE HYDRO BAN: www.laticrete.com/#sle.
 - 4) Mapei Corporation; Mapelastic AquaDefense: www.mapei.com/#sle.
 - 5) Merkrete, by Parex USA, Inc; Merkrete Hydro Guard SP-1: www.merkrete.com/#sle.
 - 6) Protecto Wrap; Protecto LM: www.protectowrap.com/#sle.
 - 7) Sika Corp; SikaTile 100 Moisture Guard: www.sika.com/#sle.
 - 8) USG Corporation; Durock Brand Waterproofing Membrane: www.usg.com/#sle.
 - 9) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- C. Reinforcing Mesh: 2 by 2 inch size weave of 16/16 wire size; welded fabric, galvanized.
- D. Membrane at Walls: Placed behind the backer board.
 1. Material: No. 15 asphalt saturated felt.
- E. Metal Lath: ASTM C847 Flat diamond mesh, of weight to suit application, galvanized finish.
- F. Backer Board: Cementitious type complying with ANSI A118.9; high density, glass fiber reinforced, 7/16 inch thick; 2 inch wide coated glass fiber tape for joints and corners.
 1. Products:
 - a. Custom Building Products; WonderBoard Lite Backerboard: www.custombuildingproducts.com/#sle.
 - b. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
- G. Mesh Tape: 2 inch wide self-adhesive fiberglass mesh tape.

PART 3 EXECUTION

3.01 REGULATORY REQUIREMENTS FOR INSTALLATION

- A. California Plumbing Code:
 1. Floor Drains:
 - a. Floors shall be sloped maximum 2% to drains. CPC 411.4.

3.02 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within the tolerances specified for that type of work and are ready to receive tile.

1. Walls and floors to be level, plumb and true to within the listed for each applicable TCNA (HB) assembly method used.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive tile.
- C. Verify that subfloor surfaces are dust free and free of substances that could impair bonding of setting materials to subfloor surfaces.
- D. Cementitious Subfloor Surfaces: Verify that substrates are ready for tiling installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 05 61.
 2. Obtain instructions if test results are not within limits recommended by tiling material manufacturer and setting material manufacturer.
 3. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- E. Verify that required floor-mounted utilities are in correct location.

3.03 PREPARATION

- A. Protect surrounding work from damage.
- B. Shade work from direct sunlight during tile installation as needed to prevent rapid evaporation caused by excessive heat.
- C. Vacuum clean surfaces and damp clean.
- D. Seal substrate surface cracks with filler. Level existing substrate surfaces to acceptable flatness tolerances.
- E. Install backer board in accordance with ANSI A108.11 and board manufacturer's instructions. Tape joints and corners, cover with skim coat of setting material to a feather edge.
- F. Prepare substrate surfaces for adhesive installation in accordance with adhesive manufacturer's instructions.

3.04 INSTALLATION - GENERAL

- A. Waterproof/Anti-Fracture Membrane Application: Comply with manufacturer's written instructions and recommendations for substrate, tile setting method and Project conditions.
- B. Expansion Joints: Provide expansion joints at locations and spacings as recommended by TCNA (HB) Detail EJ171 and as indicated on Drawings. Keep joints free of setting bed mix and grout.
- C. Lay tile to pattern indicated. Do not interrupt tile pattern through openings.
- D. Cut and fit tile to penetrations through tile, leaving sealant joint space. Form corners and bases neatly. Align floor joints.
- E. Place tile joints uniform in width, subject to variance in tolerance allowed in tile size. Make grout joints without voids, cracks, excess mortar or excess grout, or too little grout.
- F. Form internal angles square and external angles bullnosed.
- G. Install non-ceramic trim in accordance with manufacturer's instructions.
- H. Install thresholds where indicated.
- I. Sound tile after setting. Replace hollow sounding units.
- J. Keep control and expansion joints free of mortar, grout, and adhesive.
- K. Prior to grouting, allow installation to completely cure; minimum of 48 hours.

- L. Grout tile joints unless otherwise indicated. Use standard grout unless otherwise indicated.
- M. At changes in plane and tile-to-tile control joints, use tile sealant instead of grout, with either bond breaker tape or backer rod as appropriate to prevent three-sided bonding.

3.05 INSTALLATION - FLOORS - THIN-SET METHODS

- A. Over interior concrete substrates, install in accordance with TCNA (HB) Method F113, dry-set or latex-Portland cement bond coat, with standard grout, unless otherwise indicated.
 - 1. Where waterproofing membrane is indicated, install in accordance with TCNA (HB) Method F122, with latex-Portland cement grout.
- B. Install tile-to-tile floor movement joints in accordance with TCNA (HB) Method EJ171F.

3.06 INSTALLATION - FLOORS - FLOATING

- A. Install in accordance with manufacturer's instructions.
- B. Grout with standard grout as specified above.

3.07 INSTALLATION - WALL TILE

- A. Over cementitious backer units on studs, install in accordance with TCNA (HB) Method W244, using membrane at toilet rooms.

3.08 GROUTING

- A. Joint Width: As follows unless indicated otherwise on Drawings.
 - 1. Glazed Wall Tile, Unmounted: As determined by spacing lugs.
 - 2. Porcelain Floor Tile: 1/4 inch.
 - 3. Mounted Tile: As determined by factory-produced spacing.
 - 4. Trim and Accessories: Match adjoining tile units.
- B. Wall Tile Grouting: TCNA/ANSI A108.10, latex-portland cement.
- C. Floor Tile Grouting: TCNA/ANSI A108.10, latex-portland cement.
- D. Do not begin grouting tiles until they are firmly set and a minimum of 48 hours of curing has occurred.
- E. Remove spacers, ropes, glue, and similar foreign matter prior to grouting.
- F. When using proprietary grout, comply with manufacturer's instructions and recommendations unless otherwise more stringent requirements are specified.
- G. Force maximum amount of approved grout into joints in accordance with pertinent recommendations contained in TCNA/ANSI A108.10.
- H. Fill joints of cushion-edge tile to depth of cushion; fill joints of square-edge tile flush with tile surface.
- I. Fill all gaps and skips.
- J. Do not permit mortar or mounting mesh to show through grouted joints.
- K. Provide hard finished grout which is uniform in color, smooth, and without voids, pin holes, or low spots.
- L. Leave tile clean.

3.09 TOLERANCES

- A. Subsurface Guidelines: Refer to TCNA (HB) for a complete guidelines.

Mortar Bed	1/4 inch: 10 feet
Thin Bed w/ cementitious bonding material w/ Tiles <15"	1/4 inch: 10 feet from plane Maximum 1/16 inch variation in 12 inches from high points.
Thin Bed w/ cementitious bonding material w/ Tiles any side >15"	1/8 inch: 10 feet from plane Maximum 1/16 inch variation in 24 inches from high points.
Thin Bed w/ organic adhesive bonding material w/ Tiles any side >15"	1/16 inch in 3 feet No abrupt irregularities >1/32 inch

- B. Lippage Guidelines: Refer to TCNA (HB) for a complete guidelines.

Tile Type	Tile Size (in.)	Joint Width (in.)	Allowable Lippage (in.)
Glazed Wall/ Mosaics	1 x 1 to 6 x 6	1/16 to 1/8	1/32
Quarry	6 x 6 to 8 x 8	1/4 or greater	1/16
Pressed Floor and Porcelain Tiles	All	1/16 to less than 1/4	1/32
Pressed Floor and Porcelain Tiles	All	1/4 or greater	1/16

3.10 JOINT SEALANT

- A. Apply sealant after tile is grouted, grout is cured and tile field is thoroughly clean and dry.
- B. Seal between tile and all penetrating elements.
- C. Seal perimeter of tile field where tile base is not provided.
- D. Sealant Locations shall include:
 - 1. Around plumbing penetrations.
 - 2. Around door frames and other items set in wall.
- E. Refer to Section 07 92 00 - Joint Sealants for additional requirements.

3.11 GROUT SEALER

- A. Clean grout and apply sealer in accordance with manufacturer's instructions and recommendations.

3.12 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide manufacturer's field representative to inspect waterproofing.
- C. Repair or remove and reinstall as required.
- D. Repeat until a satisfactory result is achieved.

3.13 CLEANING

- A. Clean tile and grout surfaces.

3.14 PROTECTION

- A. Do not permit traffic over finished floor surface for 4 days after installation.

END OF SECTION

SECTION 09 51 00 ACOUSTICAL CEILINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units; ACT-1.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Division 23 - Heating, Ventilating, and Air-Conditioning (HVAC) - Air Outlets and Inlets: Air diffusion devices in ceiling.
- C. Division 26 - Electrical - Interior Lighting: Light fixtures in ceiling system.
- D. Division 27 - Communications - Public Address Systems: Speakers in ceiling system.

1.03 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures.
- B. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- C. ASTM C635/C635M - Standard Specification for Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.
- D. ASTM C636/C636M - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- F. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.
- G. ASTM E1264 - Standard Classification for Acoustical Ceiling Products.
- H. CHPS (HPPD) - High Performance Products Database.
- I. DSA IR 16-9 - Pendant Luminaires.
- J. DSA IR 25-1 - Maximum Allowable Load for Ceiling Wires.
- K. DSA IR 25-2 - Suspended Lay-In Panel Ceiling.
- L. DSA IR A-5 - Acceptance of Products, Materials, and Evaluation Reports.
- M. UL (GGG) - GREENGUARD Gold Certified Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Shop Drawings: Indicate grid layout and related dimensioning, junctions with other ceiling finishes, and mechanical and electrical items installed in the ceiling.
- C. Product Data: Provide data on suspension system components and acoustical units.
- D. Evaluation Service Reports: Show compliance with specified requirements.
 - 1. Submit copies of the suspension system manufacturer's current ICC Evaluation Service Report.
- E. Samples: Submit two samples 12 by 12 inch in size illustrating material and finish of acoustical units.
- F. Samples: Submit two samples each, 12 inches long, of suspension system main runner, cross runner, and perimeter molding.
- G. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- H. Manufacturer's qualification statement.
- I. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Exposed Suspension System Components: Furnish quantity of each exposed suspension component equal to 1.0 percent of amount installed.
 - 3. Extra Acoustical Units: Quantity equal to 5 percent of total installed.

1.06 QUALITY ASSURANCE

- A. Suspension System Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- B. Acoustical Unit Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.07 FIELD CONDITIONS

- A. Maintain uniform temperature of minimum 60 degrees F, and maximum humidity of 40 percent prior to, during, and after acoustical unit installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Acoustic Tiles/Panels:
 - 1. Armstrong World Industries, Inc: www.armstrong.com/#sle.
 - 2. CertainTeed Corporation: www.certainteed.com/#sle.
 - 3. Rockfon: www.rockfon.com/#sle.
 - 4. USG Corporation: www.usg.com/#sle.
 - 5. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Suspension Systems:
 - 1. Same as for acoustical units.

2. Rockfon, LLC: www.rockfon.com/#sle.
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PERFORMANCE 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.
 1. Class A Flame spread rating 0-15, smoke developed 0-15 per ASTM E84 for each acoustical tile type.
- B. Seismic Performance: Ceiling systems designed to withstand the effects of earthquake motions determined according to ASCE 7 for Seismic Design Category D, E, or F and complying with the following:
 1. Local authorities having jurisdiction.
 2. ICC-ES Evaluation Report No. ESR-1308.
 3. Seismic Requirements: Furnish and install suspension systems in accordance with the suspension system manufacturer's current ICC Evaluation Service Report; the California Building Code (CBC), Title 24 Part 2, Section 1617A.1.21; CBC Title 24 Part 2, Chapter 25.
 - a. Include the following Interpretation of Regulations, issued by the Division of the State Architect (DSA).
 - 1) DSA IR A-5: Acceptance of Products, Materials, and Evaluation Reports.
 - 2) DSA IR 16-9: Pendant Luminaires.
 - 3) DSA IR 25-1: Maximum Allowable Load for Ceiling Wires.
 - 4) DSA IR 25-2: Suspended Lay-In Panel Ceiling; Revised 11/3/23.

2.03 ACOUSTICAL UNITS

- A. Acoustical Units - General: ASTM E1264, Class A.
 1. VOC Content: Certified as Low Emission by one of the following:
 - a. Product listing in UL (GGG).
 - b. Product listing in CHPS (HPPD).
- B. Total System Weight: Less than 4 PSF.
- C. Acoustical Panels: Mineral fiber with membrane-faced overlay, with the following characteristics:
 1. Application(s): ACT-1.
 2. Classification: ASTM E1264 Type IV.
 - a. Form: 2, water felted.
 - b. Pattern: "E" - lightly textured.
 3. ACT-1 Size: 24 by 48 inches.
 4. Thickness: 3/4 inch.
 5. Panel Edge: Tegular.
 6. Color: White.
 7. Suspension System Type GR-1: Exposed grid.

8. Basis of Design Product: Ultima as manufactured by Armstrong World Industries, or equal.

2.04 SUSPENSION SYSTEM(S)

- A. Metal Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with perimeter moldings, hold down clips, stabilizer bars, clips, and splices as required.
 1. Materials:
 - a. Steel Grid: ASTM A653/A653M, G30 coating, unless otherwise indicated.
- B. Exposed Suspension System, Type TBAR-2: Hot-dip galvanized steel grid and cap.
 1. Application(s): Seismic.
 2. Structural Classification: Intermediate-duty, when tested in accordance with ASTM C635/C635M.
 3. Profile: Tee; 9/16 inch face width.
 4. Finish: Baked enamel.
 5. Color: White.
 6. Basis of Design Product: ICC ESR 1308, Suprafine Main Runners: XL7500; and compatible cross runners as manufactured by Armstrong World Industries, or equal.

2.05 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application, seismic requirements, and ceiling system flatness requirement specified.
- B. Hanger Wire: 12 gauge, 0.105 inch galvanized steel wire.
- C. Hold-Down Clips: Manufacturer's standard clips to suit application.
- D. Seismic Clips: Manufacturer's standard clips for seismic conditions and to suit application.
 1. Conform to seismic requirements indicated in the ESR approval documents.
- E. Perimeter Moldings: Same metal and finish as grid.
 1. Size: As required for installation conditions and specified Seismic Design Category.
 2. Angle Molding: L-shaped, for mounting at same elevation as face of grid.
- F. Acoustical Insulation: ASTM C665 friction fit type, unfaced batts.
 1. Thickness: 2 inch.
 2. Size: To fit acoustical suspension system.
- G. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.02 PREPARATION

- A. Install after major above-ceiling work is complete.

1. Complete and obtain approval of mechanical, electrical and other work above the ceiling line, before start of acoustical ceiling installation.
- B. Coordinate the location of hangers with other work.

3.03 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636/C636M, ASTM E580/E580M, and manufacturer's instructions and as supplemented in this section.
 1. Conform to DSA IR 25-2 Metal Suspension Systems for Lay-In Panel Ceilings.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.
- C. Lay out system to a balanced grid design with edge units no less than 50 percent of acoustical unit size.
- D. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 1. Use longest practical lengths.
- E. Seismic Suspension System, Seismic Design Categories D, E, F: Hang suspension system with grid ends attached to the perimeter molding on two adjacent walls; on opposite walls, maintain a 3/4 inch clearance between grid ends and wall.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.

3.04 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- E. Cutting Acoustical Units:
 1. Cut to fit irregular grid and perimeter edge trim.
 2. Make field cut edges of same profile as factory edges.
 3. Double cut and field paint exposed reveal edges.
- F. Install hold-down clips on panels within 20 ft of an exterior door.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Coordination of Other Tests and Inspections: District will employ independent testing agency to test and/or inspect anchors; provide access and assistance as required to accommodate timely performance.

- C. Testing (per DSA IR 25-2): All field testing must be performed in the presence of the project inspector or a special inspector.
 - 1. New Installations:
 - a. Post-installed anchors in concrete used to support hanger wires shall be tested at a frequency of 10 percent.
 - 1) Power actuated fasteners in concrete shall be field tested for 200 lbs. in tension. All other post-installed anchors in concrete shall be tested in accordance with CBC Section 1910A.5.
 - b. Post-installed anchors in concrete used to attach bracing wires shall be tested at a frequency of 50 percent in accordance with CBC Section 1910A.5.

3.06 TOLERANCES

- A. Maximum Variation from Flat and Level Surface: 1/8 inch in 10 feet.
- B. Maximum Variation from Plumb of Grid Members Caused by Eccentric Loads: 2 degrees.

3.07 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Clean surfaces.
- C. Replace damaged or abraded components.

3.08 ADJUSTING AND CLEANING

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

END OF SECTION

SECTION 09 65 00 RESILIENT FLOORING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Resilient base. RB-1
- B. Installation accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI A326.3 - American National Standard Test Method for Measuring Dynamic Coefficient of Friction of Hard Surface Flooring Materials.
- C. ANSI/NFSI B101.3 - Test Method for Measuring the Wet DCOF of Hard Surface Walkways.
- D. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- E. ASTM F150 - Standard Test Method for Electrical Resistance of Conductive and Static Dissipative Resilient Flooring.
- F. CBC Ch. 11B - California Building Code-Chapter 11B.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.
- H. RFCI (RWP) - Recommended Work Practices for Removal of Resilient Floor Coverings.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- C. Verification Samples: Submit two samples, 2 by 2 inch in size illustrating color and pattern for each resilient flooring product specified.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Wall Base: 50 linear feet of each type and color.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified flooring with minimum three years documented experience.

- B. Installer Qualifications: Company specializing in installing specified flooring with minimum three years documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Upon receipt, immediately remove any shrink-wrap and check materials for damage and the correct style, color, quantity and run numbers.
- B. Store all materials off of the floor in an acclimatized, weather-tight space.
- C. Maintain temperature in storage area between 55 degrees F and 90 degrees F.
- D. Do not double stack pallets.

1.07 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70 degrees F to achieve temperature stability. Thereafter, maintain conditions above 55 degrees F.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Provide products complying with the most stringent requirements of local, state, and federal regulations; where requirements of the contract documents exceed those of regulations, comply with the contract documents.
- B. Requirements for Physically Disabled: Provide flooring meeting slip-resistant requirements of California Code of Regulations (CCR), Title 24, Part 2, Chapter 11B and ADA Standards, latest amendment.
 - 1. Flooring surface shall be stable, firm, and slip resistant. CBC Section 11B-302.1 General.
 - 2. Flooring surface demonstrating a dynamic coefficient of friction of at least 0.42 wet per DCOF AcuTest ANSI A326.3, or ANSI/NFSI B101.3 (using a BOT-3000 testing unit) will be accepted as meeting the intent of slip resistance; CBC Ch. 11B-302 Floor or Ground Surfaces and ADA Standards.
 - a. Ramp surface: Provide DCOF value of 0.46.
- C. Comply with CalGreen Building Standards: 80 percent of the installed resilient flooring shall meet one of the following:
 - 1. VOC Content: Certified as Low Emission by one of the following :
 - a. SCS Floorscore; www.scs-certified.com. CalGreen 5.504.4.6.1.
 - b. Compliant with the VOC emission limits and testing requirements specified in the California Department of Public Health's 2010 "Standard Method for the Testing and Evaluation Chambers", Version 1.1, February 2010. CalGreen 5.504.4.6.2.
 - c. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database; www.chps.net/manual/lem_table.htm. CalGreen 5.504.4.6.3.
 - d. Products certified under UL GreenGuard Gold; www.greenguard.org. CalGreen 5.504.4.6.4.

2.02 RESILIENT BASE

- A. Resilient Base - Type RB-1: ASTM F1861, Type TV, vinyl, thermoplastic; Style B, Cove.
 - 1. Basis of Design Product: Vinyl Wall Base as manufactured by Roppe, or approved equal.
 - 2. Manufacturers:
 - a. Armstrong; Wall Base: www.armstrongflooring.com.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Mannington Commercial; Burke: www.manningtoncommercial.com#sle.
 - d. Roppe Corporation: www.roppe.com/#sle.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Critical Radiant Flux (CRF): Minimum 0.45 watt per square centimeter, when tested in accordance with ASTM E 648, NFPA 253, ASTM E 648, or NFPA 253.
 - 4. Height: 4 inches.
 - 5. Thickness: 0.125 inch.
 - 6. Finish: Satin.
 - 7. Length: Roll.
 - 8. Color: As indicated on drawings.
 - 9. Accessories: Premolded external corners and internal corners.

2.03 ACCESSORIES

- A. Primers, Adhesives, and Seam Sealer: Waterproof; types recommended by flooring manufacturer.
 - 1. VOC Content Limits: As specified in Section 01 61 16.
- B. Moldings, Transition and Edge Strips: Same material as flooring.
- C. Filler for Coved Base: Plastic.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to manufacturer, free of cracks that might telegraph through, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.
- C. Material Inspection:
 - 1. In accordance with manufacturer's installation requirements, visually inspect materials prior to installation.
 - 2. Material with visual defects shall not be installed.
 - 3. Labor costs required to replace material installed with visual defects shall be the responsibility of the installation contractor.

3.02 PREPARATION

- A. Clean substrate.

3.03 INSTALLATION - GENERAL

- A. Starting installation constitutes acceptance of sub-floor conditions. Beginning of installation means acceptance of existing substrate and site conditions and assumes responsibility for correcting unsuitable conditions at no additional cost to the District.
- B. Install in accordance with manufacturer's written instructions.
 - 1. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions, and product carton instructions for installation.
- C. Adhesive-Applied Installation:
 - 1. Spread only enough adhesive to permit installation of materials before initial set.

3.04 INSTALLATION - RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Miter internal corners. At external corners, use premolded units. At exposed ends, use premolded units.
- C. Install base on solid backing. Bond tightly to wall and floor surfaces.
- D. Scribe and fit to door frames and other interruptions.

3.05 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

3.06 PROTECTION

- A. Prohibit traffic on resilient flooring for 48 hours after installation.

END OF SECTION

SECTION 09 68 13 TILE CARPETING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Carpet tile, fully adhered. CPT-1
- B. Carpet tile walk-off mat. WM-1

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 74 19 - Construction Waste Management and Disposal: Reclamation/Recycling of new carpet tile scrap and removed carpet tile.
- C. Section 09 05 61 - Common Work Results for Flooring Preparation: Concrete slab moisture and alkalinity testing and remediation procedures.
- D. Section 09 6500 - Resilient Flooring: Topset Base.

1.03 REFERENCE STANDARDS

- A. AATCC Test Method 134 - Test Method for Electrostatic Propensity of Carpets.
- B. AATCC Test Method 16 - Colorfastness to Light.
- C. ASTM D2859 - Standard Test Method for Ignition Characteristics of Finished Textile Floor Covering Materials.
- D. ASTM D5848 - Standard Test Method for Mass Per Unit Area of Pile Yarn Floor Coverings.
- E. ASTM E648 - Standard Test Method for Critical Radiant Flux of Floor-Covering Systems Using a Radiant Heat Energy Source.
- F. CRI 104 - Standard for Installation of Commercial Carpet.
- G. NFPA 253 - Standard Method of Test for Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- C. Shop Drawings: Indicate layout of joints.
- D. Samples: Submit two carpet tiles illustrating color and pattern design for each carpet color selected.
- E. Submit two, 6 inch long samples of edge strip and base cap.
- F. Manufacturer's Installation Instructions: Indicate special procedures.
- G. Concrete Subfloor Test Report: Submit a copy of the moisture and alkalinity (pH) test reports.
- H. Installer's Qualification Statement.
- I. Operation and Maintenance Data: Include maintenance procedures, recommended maintenance materials, and suggested schedule for cleaning.

- J. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Carpet Tiles: Quantity equal to 5 percent of total installed of each color and pattern installed.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing specified carpet tile with minimum three years documented experience.
- B. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience and approved by carpet tile manufacturer.

1.06 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.
 - 1. Store inside, in well ventilated area, protected from weather, moisture and soiling. Store rolls flat, not standing on end.
- B. Maintain minimum 70 degrees F ambient temperature 24 hours prior to, during and 24 hours after installation.
- C. Deliver carpet materials in original mill protective wrapping with mill register numbers and tags attached.
- D. Ventilate installation area during installation and for 72 hours after installation.

1.07 WARRANTY

- A. Carpet Warranty: Provide 10-year Commercial Limited Warranty.
- B. Extended Warranty: Provide extended warranty covering edge raveling, delamination and wear exceeding 10 percent of face yarn weight for a period of 15 years after "Notice of Completion".

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. All products used for flooring installation shall comply with flammability and smoke classifications for various locations of installation. Comply with applicable requirements of California Building Code (CBC) Chapter 8.
- B. Provide glue-down installation conforming to CBC Section 11B-302.2.
 - 1. Carpet shall be securely attached and shall have a firm cushion, pad, or backing or no cushion or pad.
 - a. Carpet shall have level loop, textured loop, level cut or level cut/uncut pile texture.
 - b. Pile height shall be 1/2 inch maximum.
 - 2. Exposed edges shall be fastened to floor surfaces and shall have trim on the entire length.
 - a. Carpet edges shall comply with CBC Section 11B-303.
- C. Comply with CalGreen Building Standards: All installed carpeting shall be low VOC emissions listed. Certified as Low Emission by one of the following:
 - 1. Carpet and Rug Institute's Green Label Plus Program. CalGreen 5.504.4.4.1

2. Compliant with the VOC emission limits and testing requirements specified in the California Department of Public Health's "Standard Method for the Testing and Evaluation Chambers", Version 1.1, February 2010 or Specification 01350. CalGreen 5.504.4.4.2.
3. NSF/ANSI 140 at Gold level or higher. CalGreen 5.504.4.4.3
4. SCS Floorscore; www.scs-certified.com. CalGreen 5.504.4.4.4.
5. Compliant with the Collaborative for High Performance Schools California (CA-CHPS) Criteria Interpretation for EQ 7.0 and EQ 7.1 (formerly EQ 2.2) dated July 2012 and listed in the CHPS High Performance Product Database; www.chps.net/manual/lem_table.htm. CalGreen 5.504.4.4.5.

2.02 MANUFACTURERS

A. Tile Carpeting:

1. Mohawk Group: www.mohawkgroup.com/#sle.
2. Shaw Industries Group, Inc.: www.shawcontract.com.
3. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 MATERIALS

A. Carpet Tile (Entry or "Walk-Off" Mat)

1. Carpet, Type WM-1: Tufted Tip-Sheared, nylon.
 - a. Basis of Design Product: Indicated on Drawings as manufactured by Mohawk Group or Shaw Industries Group, Inc, or approved equal.
 - b. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
 - c. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
 - d. VOC Content: Comply with Section 01 61 16.
 - e. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity (RH).
 - f. Primary Backing: AFIRMA II Hardback Tile.
 - 1) Material: Synthetic.
 - g. Tile Size: 24 by 24 inch, nominal.
 - h. Yarn Weight: 24 oz/sq yd, ASTM D5848.
 - i. Pile Height: 0.090 to 0.198 inch.
 - j. Color: As indicated on Drawings.
2. Preferred Manufacture Location: California.
3. Recycling:
 - a. New Carpet:
 - 1) Carpet must be eligible for recycling by the supplying mill or fiber producer to an existing operational third party certified recycling center;
 - 2) Submit program parameters.
 - 3) Landfills are not an option.

B. Tile Carpeting, Type CPT-1: Tufted, Textured Loop, manufactured in one color dye lot.

1. Basis of Design Product: Indicated on Drawings as manufactured by Mohawk Group or Shaw Industries Group, Inc, or approved equal.
2. Tile Size: 24 by 24 inch, nominal.
3. Thickness: 0.35 inch.
4. Color: As indicated on Drawings.
5. Pattern: Linear.
6. Critical Radiant Flux: Minimum of 0.45 watts/sq cm, when tested in accordance with ASTM E648 or NFPA 253.
7. Surface Flammability Ignition: Pass ASTM D2859 (the "pill test").
8. VOC Content: Comply with Section 01 61 16.
9. Indoor Air Quality—CRI Green Label Plus™
10. Antimicrobial: Yes.
11. Maximum Electrostatic Charge: 3.5 Kv. at 20 percent relative humidity, AATCC Test Method 134.
12. Light Fastness: ≥ 4.0 at 80 Hours, AATCC Test Method 16.
13. Primary Backing Material: PVC-Free.

2.04 ACCESSORIES

- A. Subfloor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Resilient Base: See Section 09 65 00 - Resilient Flooring.
- C. Edge Strips: Rubber, color as selected by Architect.
 1. CON-WOM #169 Reducer manufactured by Roppe; or approved equivalent product.
- D. Adhesives:
 1. Compatible with materials being adhered; maximum VOC content as specified in Section 01 61 16.
- E. Carpet Tile Adhesive: Recommended by carpet tile manufacturer; releasable type.
 1. Water-resistant, non-staining and nonflammable type as recommended by carpet manufacturer to be compatible with backing materials.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that subfloor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.
 1. Maximum variation of 1/8-inch in 10 ft
- B. Verify that subfloor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to subfloor surfaces.
- C. Cementitious Subfloor Surfaces: Verify that substrates are ready for flooring installation by testing for moisture and alkalinity (pH).
 1. Test in accordance with Section 09 05 61.
 2. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

- 3. Follow moisture and alkalinity remediation procedures in Section 09 05 61.
- D. Carpet Verification: Verify carpet match before cutting or placement to ensure minimal variation between dye lots.
- E. Verify that required floor-mounted utilities are in correct location.

3.02 PREPARATION

- A. Prepare floor substrates for installation of flooring in accordance with Section 09 05 61.

3.03 INSTALLATION

- A. Starting installation constitutes acceptance of subfloor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI 104 (Commercial).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Lay carpet tile in square pattern, with pile direction parallel to next unit, set parallel to building lines.
 - 1. Locate change of color or pattern between rooms under door centerline.
- F. Locate change of color or pattern between rooms under door centerline.
- G. Fully adhere carpet tile to substrate.
- H. Trim carpet tile neatly at walls and around interruptions.
 - 1. Edges: Run carpet under open bottom items and all cabinets and install tight to walls. Neatly trim and secure edge of carpet adjacent to door jambs where no base occurs.
- I. Complete installation of edge strips, concealing exposed edges.
- J. Carpet Finishing: Brush all seams and trim protruding pile tufts level. Remove excess adhesive on the carpet surface and thoroughly vacuum entire area. Leave room clean and ready for use.

3.04 PROTECTION

- A. Cover carpet during construction period with reinforced kraft paper when construction traffic is required to cross carpeted areas.
- B. Remove and replace damaged or improperly installed carpet.

3.05 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.
 - 1. Vacuum and remove all stains from carpet to satisfaction of District and in accordance with cleaning specified in Section 01 70 00 - Execution and Closeout Requirements.

END OF SECTION

SECTION 09 91 13 EXTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Materials for backpriming woodwork.
- D. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated, including the following:
 - 1. Exposed surfaces of steel lintels and ledge angles.
 - 2. Mechanical and Electrical:
 - a. On the roof and outdoors, paint equipment exposed to weather or to view, including factory-finished materials.
- E. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, and operating parts of equipment.
 - 5. Non-metallic roofing and flashing.
 - 6. Stainless steel, anodized aluminum, bronze, terne-coated stainless steel, zinc, and lead.
 - 7. Floors, unless specifically indicated.
 - 8. Glass.
 - 9. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.

- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- E. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- F. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- G. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- H. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years documented experience, approved by manufacturer, and with minimum three years documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the paint product manufacturer's temperature ranges.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply exterior paint and finishes during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- D. Minimum Application Temperatures for Latex Paints: 50 degrees F for exterior; unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - a. Local representative Joe Esquer, 657.212.0111.
 - 2. Dunn-Edwards Corporation: www.dunnedwards.com,
 - a. Local representative Wanda Barragan 909.261.1289.
 - 3. PPG Paints: www.ppgpaints.com/#sle.
 - a. Local representative Susan L. Giampietro 949.410.2452.
 - 4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - a. Local representative John Dumesnil 619.665.9341.
 - b. Local representative Rocky Berlanga 657.269.0922.
 - 5. Vista Paint Corporation: www.vistapaint.com/#sle.
 - a. Local representative Mark Brower 323.397.9000.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless required to be a field-catalyzed paint.

1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is described explicitly in manufacturer's product instructions.
- B. No intentionally added cadmium.
- C. Volatile Organic Compound (VOC) Content: Comply with Section 01 61 16.
- D. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - d. Architectural coatings VOC limits of California.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- E. Flammability: Comply with applicable code for surface burning characteristics.
- F. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- G. Colors: As indicated in Color Schedule.
1. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 PAINT SYSTEMS - EXTERIOR

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including cement board, primed wood, and primed metal.
1. One or two coats to cover and one coat primer.
 2. Top Coat(s): Exterior Latex.
 3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen at all locations.
 - b. Semi-Gloss: MPI gloss level 5; use this sheen at trim.
 4. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Wood, Opaque, Acrylic Latex, 3 Coat:
1. One coat of latex primer sealer.
 2. Semi-gloss: Two coats of acrylic latex enamel.

3. Flat: Two coats of acrylic latex.
- C. Ferrous Metals, Unprimed, Latex, 3 Coat:
 1. One coat of latex primer.
 2. Semi-gloss: Two coats of latex enamel.
- D. Ferrous Metals, Primed, Latex, 2 Coat:
 1. Touch-up with rust-inhibitive primer recommended by top coat manufacturer.
 2. Semi-gloss: Two coats of latex enamel.
- E. Ferrous Metals, Unprimed, High-Performance, 3 Coat:
 1. Pre-Treatment: As recommended by manufacturer
 2. One coat galvanize primer.
 3. Gloss: Two coats of alkyd enamel.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Alkali Resistant Water Based Primer.
 2. Anti-Corrosive Alkyd Primer for Metal.
 3. Interior/Exterior Quick Dry Alkyd Primer for Metal.
 4. Alkyd Primer for Galvanized Metal.
 5. Water Based Primer for Galvanized Metal.
 6. Rust-Inhibitive Water Based Primer.
 7. Interior/Exterior Quick Dry Primer for Aluminum.
 8. Stain Blocking Primer.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Exterior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or repair existing paints or finishes that exhibit surface defects.
- D. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- E. Seal surfaces that might cause bleed through or staining of topcoat.
- F. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- G. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- H. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- I. Exterior Wood Surfaces to Receive Opaque Finish: Remove dust, grit, and foreign matter. Seal knots, pitch streaks, and sappy sections. Fill nail holes with tinted exterior calking compound after prime coat has been applied. Back prime concealed surfaces before installation.
- J. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Exterior Wood to Receive Opaque Finish: If final painting must be delayed more than 2 weeks after installation of woodwork, apply primer within 2 weeks and final coating within 4 weeks.
- C. Apply products in accordance with manufacturer's written instructions.
- D. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- E. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- F. Apply each coat to uniform appearance.
- G. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply additional coats until complete hide is achieved.
- H. Sand metal surfaces lightly between coats to achieve required finish.
- I. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- J. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

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

END OF SECTION

SECTION 09 91 23 INTERIOR PAINTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Materials for backpriming woodwork.
- D. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
 - 1. Both sides and edges of plywood backboards for electrical and telecom equipment before installing equipment.
 - 2. Prime surfaces to receive wall coverings.
 - 3. Mechanical and Electrical:
 - a. In finished areas, paint insulated and exposed pipes, conduit, boxes, insulated and exposed ducts, hangers, brackets, collars and supports, mechanical equipment, and electrical equipment, unless otherwise indicated.
- E. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concealed pipes, ducts, and conduits.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.

- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- G. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- H. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- I. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- J. SSPC-SP 13 - Surface Preparation of Concrete; 2018.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g., "alkyd enamel").
 - 2. MPI product number (e.g., MPI #47).
 - 3. Cross-reference to specified paint system products to be used in project; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of substitutions proposed.
- C. Samples: Submit three paper "draw down" samples, 8-1/2 by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
 - 2. Where sheen is not specified, discuss sheen options with Architect before preparing samples, to eliminate sheens not required.
- D. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Maintenance Data: Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and finished surfaces, and color samples of each color and finish used.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Paint and Finish Materials: 1 gal of each color; from the same product run, store where directed.
 - 3. Label each container with color in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified, with minimum three years documented experience.
- B. Applicator Qualifications: Company specializing in performing the type of work specified with minimum three years experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperatures for Paints: 50 degrees F for interiors unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide paints and finishes from the same manufacturer to the greatest extent possible.
 - 1. If a single manufacturer cannot provide specified products; minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Paints:
 - 1. Behr Process Corporation: www.behr.com/#sle.
 - a. Local representative Joe Esquer, 657.212.0111.
 - 2. Dunn-Edwards Corporation: www.dunnedwards.com,
 - a. Local representative Wanda Barragan 909.261.1289.
 - 3. PPG Paints: www.ppgpaints.com/#sle.
 - a. Local representative Susan L. Giampietro 949.410.2452.
 - 4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 - a. Local representative John Dumesnil 619.665.9341.
 - b. Local representative Rocky Berlanga 657.269.0922.
 - 5. Vista Paint Corporation: www.vistapaint.com/#sle.
 - a. Local representative Mark Brower 323.397.9000.
- C. Primer Sealers: Same manufacturer as top coats.
- D. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready-mixed, unless intended to be a field-catalyzed paint.
 - 1. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 - 2. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 - 3. For opaque finishes, tint each coat including primer coat and intermediate coats, one-half shade lighter than succeeding coat, with final finish coat as base color.
 - 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 - 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. No intentionally added cadmium.
- C. Volatile Organic Compound (VOC) Content:
 - 1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - d. Ozone Transport Commission (OTC) Model Rule, Architectural, Industrial, and Maintenance Coatings; www.otcair.org; specifically:
 - 1) Opaque, Flat: 50 g/L, maximum.
 - 2) Opaque, Nonflat: 150 g/L, maximum.
 - 3) Opaque, High Gloss: 250 g/L, maximum.
 - e. Architectural coatings VOC limits of California.
 - 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- F. Colors: As indicated on drawings.
 - 1. Extend colors to surface edges; colors may change at any edge as directed by Architect.
 - 2. In finished areas, finish pipes, ducts, conduit, and equipment the same color as the wall/ceiling under which they are mounted.

2.03 PAINT SYSTEMS - INTERIOR

- A. Paint I-OP - Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board, wood, uncoated steel, shop primed steel, and galvanized steel.
 - 1. Two top coats and one coat primer.

2. Top Coat(s): Interior Latex.
3. Top Coat Sheen:
 - a. Flat: MPI gloss level 1; use this sheen for ceilings and other overhead surfaces.
 - b. Eggshell: MPI gloss level 3; use this sheen at all locations.
 - c. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
- B. Medium Duty Door/Trim: For surfaces subject to frequent contact by occupants, including metals and wood:
 1. Medium duty applications include doors, door frames, railings, handrails, and guardrails.
 2. Two top coats and one coat primer.
 3. Primer: As recommended by top coat manufacturer for specific substrate.
- C. Medium Duty Vertical and Overhead: Including gypsum board, concrete, uncoated steel, shop primed steel, galvanized steel, and aluminum.
 1. Two top coats and one coat primer.
 2. Studio Walls: Water-based, acrylic theatrical primer & sealant.
 - a. Egg-Shell: Two Coats of Tough-Prime by Rosco Laboratories or approved equal product.
 - b. Color: No. 5711 Chroma Key Green.
- D. Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
 1. Shop primer by others.
 2. One top coat.
 3. Top Coat: Latex Dry Fall.
- E. Ferrous Metals, Unprimed, Latex, 3 Coat:
 1. One coat of latex primer.
 2. Semi-gloss: Two coats of latex enamel.
- F. Ferrous Metals, Primed, Latex, 2 Coat:
 1. Touch-up with latex primer.
 2. Semi-gloss: Two coats of latex enamel.
- G. Galvanized Metals, Latex, 3 Coat:
 1. One coat galvanize primer.
 2. Semi-gloss: Two coats of latex enamel.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
 1. Interior Institutional Low Odor/VOC Primer Sealer.
 2. Interior/Exterior Latex Block Filler.
 3. Interior Latex Primer Sealer.
 4. Interior Drywall Primer Sealer.
 5. Anti-Corrosive Alkyd Primer for Metal.

6. Interior Rust-Inhibitive Water Based Primer.
7. Interior Water Based Primer for Galvanized Metal.
8. Interior Alkyd Enamel Undercoat.
9. Stain Blocking Primer.
10. Stain Blocking Primer, Water Based.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of paints and finishes until substrates have been adequately prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- D. Test shop-applied primer for compatibility with subsequent cover materials.
- E. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces is below the following maximums:
 1. Gypsum Wallboard: 12 percent.
 2. Masonry, Concrete, and Concrete Masonry Units: 12 percent.
 3. Interior Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Concrete:
 1. Remove release agents, curing compounds, efflorescence, and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces to be coated exceeds that permitted in manufacturer's written instructions.
 2. Prepare surface as recommended by top coat manufacturer and according to SSPC-SP 13.
- F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Aluminum: Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- H. Galvanized Surfaces:
 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.

2. Prepare surface according to SSPC-SP 2.
- I. Ferrous Metal:
 1. Solvent clean according to SSPC-SP 1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 Commercial Blast Cleaning. Protect from corrosion until coated.
- J. Wood Surfaces to Receive Opaque Finish: Wipe off dust and grit prior to priming. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried; sand between coats. Back prime concealed surfaces before installation.
- K. Wood Doors to be Field-Finished: Seal wood door top and bottom edge surfaces with clear sealer.
- L. Metal Doors to be Painted: Prime metal door top and bottom edge surfaces.

3.03 APPLICATION

- A. Remove unfinished louvers, grilles, covers, and access panels on mechanical and electrical components and paint separately.
- B. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- C. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- D. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- E. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- F. Dark Colors and Deep Clear Colors: Regardless of number of coats specified, apply as many coats as necessary for complete hide.
- G. Sand wood and metal surfaces lightly between coats to achieve required finish.
- H. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- I. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection.
- B. District will provide field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

- A. Protect finishes until completion of project.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 93 00 STAINING AND TRANSPARENT FINISHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Field application of stains.
- B. Field application of transparent finishes.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 91 13 - Exterior Painting: Stains and transparent finishes for concrete substrates.
- C. Section 09 91 23 - Interior Painting: Stains and transparent finishes for concrete substrates.

1.03 DEFINITIONS

- A. Comply with ASTM D16 for interpretation of terms used in this section.

1.04 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D16 - Standard Terminology for Paint, Related Coatings, Materials, and Applications; 2024.
- C. ASTM D4442 - Standard Test Methods for Direct Moisture Content Measurement of Wood and Wood-Based Materials; 2020.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- E. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- F. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and catalog number, and general product category.
 - 2. Manufacturer's installation instructions.
- C. Samples: Submit two samples, illustrating selected colors and sheens for each system with specified coats cascaded. Submit on actual wood substrate to be finished, 8 by 8 inch in size.
- D. Certification: By manufacturer that stains and transparent finishes comply with VOC limits specified.
- E. Manufacturer's Instructions: Indicate special surface preparation procedures.
- F. Manufacturer's Qualification Statement.
- G. Applicator's Qualification Statement.

- H. Maintenance Data: Submit data including finish schedule showing where each product, color, and finish was used, product technical data sheets, safety data sheets (SDS), care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.
- I. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Stock Materials: Stain and transparent finish materials, 1 gal of each color and type; store where directed.
 - 3. Label each container with color and type in addition to the manufacturer's label.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section, with at least three years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of stain or transparent finish, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Stain and Transparent Finish Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.08 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by manufacturer of stains and transparent finishes.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Do not apply materials when relative humidity exceeds 85 percent, at temperatures less than 5 degrees F above the dew point, or to damp or wet surfaces.
- D. Minimum Application Temperature: 50 degrees F unless required otherwise by manufacturer's instructions.
- E. Provide lighting level of 80 fc measured mid-height at substrate surface.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide finishes from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. Transparent Finishes:
 - 1. Behr Process Corporation: www.behr.com/#sle.

2. Bona US: www.bona.com/#sle.
 3. PPG Paints: www.ppgpaints.com/#sle.
 4. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 5. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Stains:
1. Behr Process Corporation: www.behr.com/#sle.
 2. PPG Paints: www.ppgpaints.com/#sle.
 3. Sherwin-Williams Company: www.sherwin-williams.com/#sle.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 STAINS AND TRANSPARENT FINISHES - GENERAL

- A. Finishes:
1. Provide finishes capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 2. Provide materials compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 3. Supply each finish material in quantity required to complete entire project's work from a single production run.
 4. Do not reduce, thin, or dilute finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. No intentionally added cadmium.
- C. Volatile Organic Compound (VOC) Content:
1. Provide stains and transparent finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. SCAQMD 1113 Rule.
 - c. CARB (SCM).
 - d. Architectural coatings VOC limits of California.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- D. Flammability: Comply with applicable code for surface burning characteristics.
- E. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect from the manufacturer's full line.
- F. Colors: To be selected from manufacturer's full range of available colors.
1. Selection to be made by Architect after award of contract.
 2. Extend colors to surface edges; colors may change at any edge as directed by Architect.

2.03 EXTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

- A. Finish on Wood - Trim:

1. Stain: Exterior Solid Stain for Wood, Water Based.
 - a. Products:
 - 1) Behr Premium Solid Color Waterproofing Stain No.5011 Tintable White (MPI #16).
 - 2) PPG Paints Flood Pro Series Solid Color Stain, FLD820 Series. (MPI #16)
 - 3) Sherwin-Williams WoodScapes Acrylic Solid Color Stain. (MPI #16)
 - 4) Wolman by Rust-Oleum Corporation DuraStain One Coat Solid Color Stain: www.rustoleum.com/#sle. (MPI #16)
 - 5) Substitutions: Section 01 60 00 - Product Requirements.
2. Stain: Exterior Semi-Transparent Stain for Wood, Water Based.
 - a. Products:
 - 1) Behr Premium Semi-Transparent Waterproofing Stain No.5077 Tint Base.
 - 2) PPG Paints ProLuxe SRD Semi-Transparent Wood Finish, SIK500-190, Matte. (MPI #156)
 - 3) Sherwin-Williams WoodScapes Polyurethane Semi-Transparent Stain.
 - 4) Wolman by Rust-Oleum Corporation DuraStain One Coat Semi-Transparent Stain: www.rustoleum.com/#sle.
 - 5) Substitutions: Section 01 60 00 - Product Requirements.
3. Stain: Exterior Semi-Transparent Stain for Wood Decks, Solvent Based or Water Based.
 - a. Products:
 - 1) PPG Paints ProLuxe SRD Semi-Transparent Wood Finish, SIK500-190, Matte. (MPI #33)
 - 2) Wolman by Rust-Oleum Corporation F&P Finish and Preservative: www.rustoleum.com/#sle. (MPI #33)
 - 3) Substitutions: Section 01 60 00 - Product Requirements.
4. Top Coat(s): Exterior Clear Water Based Varnish with UV Inhibitor.
 - a. Products:
 - 1) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT259, Satin.
 - 2) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT258, Semi-Gloss
 - 3) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT257, Gloss.
 - 4) United Gilsonite Laboratories ZAR Exterior Water Base High Performance: www.zar.com/#sle.
 - 5) Substitutions: Section 01 60 00 - Product Requirements.
5. Top Coat Sheen:
 - a. Satin: MPI gloss level 4; use this sheen at all locations.
 - b. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 - c. Gloss: MPI gloss level 6; use this sheen at all locations.
 - d. High Gloss: MPI gloss level 7; use this sheen at all locations.

2.04 INTERIOR STAIN AND TRANSPARENT FINISH SYSTEMS

A. Finish on Wood - Trim:

1. One-coat varnish over two-coat stain.
2. Stain: Semi-transparent stain for wood, water based; MPI #186.
 - a. Products:
 - 1) Behr Fast Drying Water-Based Wood Stain [B4500].
3. Stain: Semi-transparent stain for wood, water based with polyurethane.
 - a. Products:
 - 1) Behr Water-Based Wood Stain and Poly in One, Satin [B6200].
 - 2) Behr Water-Based Wood Stain and Poly in One, Gloss [B6300].
 - 3) Substitutions: Section 01 60 00 - Product Requirements.
4. Sealer: Water based, sanding sealer, clear.
5. Top Coat: Clear water-based varnish.
 - a. Products:
 - 1) Behr Fast Drying Water-Based Polyurethane [B8100].
 - 2) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT259, Satin.
 - 3) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT 258, Semi-Gloss.
 - 4) PPG Paints Deft Interior/Exterior Water-Based Polyurethane, DFT257, Gloss. (MPI #129)
 - 5) Rodda Waterborne Alkyd Urethane Varnish, 593 Series, (MPI #128, 129, 130)
 - 6) Substitutions: Section 01 60 00 - Product Requirements.
6. Top Coat Sheen:
 - a. Semi-Gloss: MPI gloss level 5; use this sheen at all locations.
 - b. Gloss: MPI gloss level 6; use this sheen at all locations.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of finished surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin application of stains and finishes until substrates have been properly prepared.
- B. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- C. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 1. Wood: 15 percent, measured in accordance with ASTM D4442.

3.02 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Wood Surfaces to Receive Transparent Finish: Wipe off dust and grit prior to sealing, seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after sealer has dried; sand lightly between coats. Prime concealed surfaces with gloss varnish reduced 25 percent with thinner.

3.03 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- C. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- D. Sand wood surfaces lightly between coats to achieve required finish.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Wood to Receive Transparent Finishes: Tint fillers to match wood. Work fillers into the grain before set. Wipe excess from surface.
- G. Reinstall items removed prior to finishing.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection.
- B. District will provide field inspection.

3.05 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.06 PROTECTION

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

END OF SECTION

SECTION 09 96 00 HIGH-PERFORMANCE COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. High performance coatings.
 - 1. Exterior Steel: AESS, exterior steel, metal canopies, exposed steel decks, hollow metal doors and frames, metal stair stringers and treads, guardrails/handrails, metal copings/flashings (not prefinished), and equipment screens,
 - 2. Epoxy on trash enclosure walls.
- B. Surface preparation.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 09 91 13 - Exterior Painting.
- C. Section 09 91 23 - Interior Painting: Requirements for mechanical and electrical equipment surfaces.
- D. Section 09 67 00 - Fluid-Applied Flooring: High performance fluid-applied flooring systems.

1.03 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. ASTM D2486 - Standard Test Methods for Scrub Resistance of Wall Paints; 2017.
- C. ASTM D4587 - Standard Practice for Fluorescent UV-Condensation Exposures of Paint and Related Coatings; 2023.
- D. CARB (SCM) - Suggested Control Measure for Architectural Coatings; California Air Resources Board; 2020.
- E. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; Current Edition.
- F. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; Current Edition.
- G. SCAQMD 1113 - Architectural Coatings; 1977, with Amendment (2016).
- H. SSPC-SP 1 - Solvent Cleaning; 2015, with Editorial Revision (2016).
- I. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- J. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting at least one week prior to the start of the work of this section; require attendance by all affected installers.
 - 1. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator, and manufacturer's representative. Review the following:
 - a. Environmental requirements.
 - b. Protection of surfaces not scheduled to be coated.

- c. Surface preparation.
- d. Application.
- e. Repair.
- f. Field quality control.
- g. Cleaning.
- h. Protection of coating systems.
- i. One-year inspection.
- j. Coordination with other work.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide complete list of all products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified coating system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
 - 5. If proposal of substitutions is allowed under submittal procedures, explanation of all substitutions proposed.
- C. Samples: Submit two samples 8 by 8 inch in size illustrating colors available for selection.
- D. Manufacturer's Certificate: Certify that high-performance coatings comply with VOC limits specified.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- F. Manufacturer's Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
- G. Maintenance Data: Include cleaning procedures and repair and patching techniques.
 - 1. Submit data including finish schedule showing where each product/color/finish was used, product technical data sheets, material safety data sheets (MSDS), care and cleaning instructions, touch-up procedures, repair of painted and coated surfaces, and color samples of each color and finish used.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Coating Materials: 1 gallon of each type and color.
 - 3. Label each container with manufacturer's name, product number, color number, and room names and numbers where used.

1.06 QUALITY ASSURANCE

- A. Maintain one copy of each referenced document that applies to application on site.
- B. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.
- C. Applicator Qualifications: Company specializing in performing the work of this section approved by manufacturer.

1.07 MOCK-UPS

- A. See Section 01 40 00 - Quality Requirements for general requirements for mock-ups.
- B. Provide mock-up , 8 feet long by 8 feet wide (or otherwise appropriate), illustrating coating, for each specified coating.
- C. Locate where directed.
- D. Mock-up may remain as part of the work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of coating, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Coating Materials: Store at minimum ambient temperature of 45 degrees F and a maximum of 90 degrees F, in ventilated area, and as required by manufacturer's instructions.

1.09 FIELD CONDITIONS

- A. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- B. Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the coating product manufacturer.
- C. Do not install materials when temperature is below 55 degrees F or above 90 degrees F.
- D. Maintain this temperature range, 24 hours before, during, and 72 hours after installation of coating.
- E. Provide lighting level of 80 ft candles measured mid-height at substrate surface.
- F. Restrict traffic from area where coating is being applied or is curing.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Warranty: Include coverage for bond to substrate.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Provide high performance coating products from the same manufacturer to the greatest extent possible.
 - 1. In the event that a single manufacturer cannot provide specified products, minor exceptions will be permitted provided approval by Architect is obtained using the specified procedures for substitutions.
 - 2. Substitution of other products by the same manufacturer is preferred over substitution of products by a different manufacturer.
- B. High-Performance Coatings:
 - 1. Behr Paint Corp.: www.behr.com.
 - 2. Carboline: www.carboline.com.

3. Dunn Edwards : www.dunnedwards.com.
4. PPG Paints: www.ppgpaints.com/#sle.
 - a. Local representative Susan L. Giampietro 949.410.2452.
5. Precision Coatings: www.precisioncoatingsinc.com/#sle.
6. Sherwin-Williams Company: www.protective.sherwin-williams.com/industries/#sle.
 - a. Local Representative: John Dumesnil, 619.665.9341.
7. Tnemec Company, Inc: www.tnemec.com/#sle.
 - a. Local Representative: Tony Hobbs, 310.637.2363.
8. Substitutions: Section 01 60 00 - Product Requirements.

2.02 HIGH-PERFORMANCE COATINGS

- A. Provide coating systems that meet the following minimum performance criteria, unless more stringent criteria are specified:
 1. Surface Burning Characteristics: Flame spread/Smoke developed index of 0/0, maximum, when tested in accordance with ASTM E84.
 2. Lead Content: None.
 3. No intentionally added cadmium.
 4. Scrubbability: Excellent, when tested in accordance with ASTM D2486.
 5. Gloss and Color Retention: Excellent, when tested in accordance with ASTM D4587.

2.03 TOP COAT MATERIALS

- A. Coatings - General: Provide complete multi-coat systems formulated and recommended by manufacturer for the applications indicated, in the thicknesses indicated; number of coats specified does not include primer or filler coat.
 1. Lead Content: Not greater than 0.06 percent by weight of total nonvolatile content.
 2. Chromium Content, as Hexavalent Chromium, Zinc Chromate, or Strontium Chromate: None.
 3. Volatile Organic Compound (VOC) Content:
 - a. Provide coatings that comply with the most stringent requirements specified in the following:
 - 1) 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - 2) SCAQMD 1113 Rule.
 - 3) CARB (SCM).
 - 4) Architectural coatings VOC limits of California.
 - b. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
 4. Colors: As indicated.
- B. Urethane Coating:
 1. Exterior Steel: AESS, exterior steel, metal canopies, exposed steel decks, hollow metal doors and frames, metal copings/flashings (not prefinished), and equipment screens,
 2. Number of Coats: Two.

3. Product Characteristics:
 - a. Comply with the performance requirements specified above for moderate exposure.
4. Top Coat(s): Acrylic Urethane, Water Based, Two-Component.
 - a. Sheen: High Gloss.
 - b. Products:
 - 1) Sherwin-Williams; Pro Industrial Waterbased Acrolon 100: www.protective.sherwin-williams.com/#sle.
 - 2) Dunn Edwards; Endura-Coat ENCT60: www.dunnedwards.com.
 - 3) Benjamin Moore; Ultra Spec HP D.T.M. Acrylic Gloss HP28: www.benjaminmoore.com.
 - 4) Tnemec Company, Inc; Series 1080 Endurashield: www.tnemec.com/#sle.
 - 5) Substitutions: Section 01 60 00 - Product Requirements.
5. Primer: As recommended by coating manufacturer for specific substrate.
- C. Multi-Component Coating for Existing Exterior Ceramic Tile:
 1. Mechanically abrade surface to ICRI CSP 3-5. Remove and patch damaged tiles.
 2. Trowel apply coat of Series 215 Surfacing Epoxy.
 3. Apply Series 273 Stranlok ML, a fiberglass mat reinforced epoxy coating system to a smooth, seamless surface.
 4. Apply a saturant coat of Series 280 Tneme-Glaze followed by another coat of the same product to seal the Stranlok system
 5. Products:
 - a. Tnemec Company, Inc: www.tnemec.com/#sle.
 - b. Substitutions: Section 01 60 00 - Product Requirements.

2.04 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by coating manufacturer.
 1. Rust-Inhibitive, Water Based; MPI #107.
 - a. Products:
 - 1) Benjamin Moore; Ultra Spec HP Acrylic Metal Primer HP04: www.benjaminmoore.com.
 - 2) Dunn Edwards; EnduraPrime ENPR00: www.dunnedwards.com.
 - 3) Sherwin-Williams; Pro Industrial Pro-Cryl Universal Primer: www.protective.sherwin-williams.com/#sle. (MPI #107)
 - 4) Tnemec Company, Inc; Series 115 Uni-Bond DF: www.tnemec.com/#sle.
 - 5) Substitutions: Section 01 60 00 - Product Requirements.

2.05 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of coated surfaces.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Do not begin application of coatings until substrates have been properly prepared.
- C. Verify that substrate surfaces are ready to receive work as instructed by the coating manufacturer. Obtain and follow manufacturer's instructions for examination and testing of substrates.
- D. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- E. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- F. Test shop-applied primer for compatibility with subsequent cover materials.
- G. Proceed with coating application only after unacceptable conditions have been corrected.
 - 1. Commencing coating application constitutes Contractor's acceptance of substrates and conditions.

3.02 PREPARATION

- A. Clean surfaces of loose foreign matter.
- B. Remove substances that would bleed through finished coatings. If unremovable, seal surface with shellac.
- C. Remove finish hardware, fixture covers, and accessories and store.
- D. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
 - 2. Prepare surface according to SSPC-SP 2.
- E. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP 1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning", and protect from corrosion until coated.

3.03 PRIMING

- A. Apply primer to all surfaces, unless specifically not required by coating manufacturer. Apply in accordance with coating manufacturer's instructions.

3.04 COATING APPLICATION

- A. Apply coatings in accordance with manufacturer's written instructions, to thicknesses specified and recommendations in MPI - Architectural Painting and Specification Manual.
- B. Apply in uniform thickness coats, without runs, drips, pinholes, brush marks, or variations in color, texture, or finish. Finish edges, crevices, corners, and other changes in dimension with full coating thickness.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for general requirements for field inspection.
- B. District will provide field inspection.
- C. Dry Film Thickness Testing: District will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

3.06 CLEANING

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

3.07 PROTECTION

- A. Protect finished work from damage.

END OF SECTION

SECTION 09 96 23 GRAFFITI-RESISTANT COATINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Graffiti-Resistant Coatings applied to exterior masonry and plaster/stucco surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 04 22 00 - Concrete Unit Masonry.
- C. Section 07 19 00 - Water Repellents: Coating applied under graffiti-resistant coating.
- D. Section 07 92 00 - Joint Sealants.
- E. Section 09 24 00 - Cement Plastering.

1.03 REFERENCE STANDARDS

- A. ASTM C140/C140M - Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units; 2023.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a meeting at least one week prior to starting work; require attendance of affected installers; invite Architect and District.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide product description.
- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention; cautionary procedures required during application.
- D. Manufacturer's Field Reports: Report whether manufacturer's "best practices" are being followed; if not, state corrective recommendations. Email report to Architect the same day as inspection occurs; mail report on manufacturer's letterhead to Architect within 2 days after inspection.
- E. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Graffiti-Resistant Coating Material: Five gallons of the type installed.
 - 3. Cleaner: Provide 5 one gallon containers of manufacturer's specified cleaner only for applied areas under 5,000 square feet, and 10 one gallon containers for applied areas over 5,000 square feet.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten years documented experience.
- B. Installer Qualifications: Company specializing in performing the work of this section approved by manufacturer.

- C. District reserves the right to provide continuous independent inspection of surface preparation and application of graffiti-resistant coating.

1.07 MOCK-UP

- A. Prepare a representative surface 36 by 36 inch in size using specified materials and preparation and application methods on surfaces identical to those to be coated; approved mock-up constitutes standard for workmanship.
 - 1. Allow sample area to cure and attack with indelible makers and spray paint.
 - 2. Installer to notify Architect, Contractor, Owner Representative, and manufacturer 72 hours prior to a cleaning demonstration.
- B. For proposed substitutions, prepare side-by-side mock-ups of specified and substitute products.
- C. Locate where directed.
- D. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in unopened packaging until ready for installation.
 - 1. Container labeling to include manufacturer's name, type of coating brand name, brand code, coverage, surface preparation, cure time, cleanup, and instructions for mixing.
- B. Store components under a dry covered area and elevated above grade.
- C. Store materials in well ventilated area, no less than 45°F and no more than 90°F, unless otherwise allowed by manufacturer.

1.09 FIELD CONDITIONS

- A. Protect liquid materials from freezing.
- B. Do not apply graffiti-resistant coating when ambient temperature is lower than 50 degrees F or higher than 90 degrees F.
- C. Do not apply graffiti-resistant coatings when wind velocity is higher than 10 mph.
- D. Do not apply coatings during rain, or if rain is imminent within 48 hours.

1.10 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide two year manufacturer warranty for labor.
- D. Provide ten year manufacturer warranty for materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Silane/Siloxane Graffiti-Resistant Coatings:
 - 1. Sherwin-Williams Company; Anti-Graffiti Coating: www.sherwin-williams.com.
 - 2. PROSOCO, Inc.; Blok-Guard® & Graffiti Control Ultra 15: www.prosoco.com.
 - 3. Rainguard Products Co.; VandlGuard Ten (2 coats) and VandlGuard Finish Coat, Non-Sacrificial; www.rainguard.com.
 - 4. SEI Chemical; SCS-002SP Sealer and GPA-300 Graffiti Proofer (Non-Sacrificial): www.seichemical.com.

5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Exact product to be used will be determined by side-by-side mock-up testing of at least 3 products meeting specified requirements; prepare mock ups as specified above; submit cost breakdown for each product used in mock-up, including both unit and total costs.
- B. Graffiti-Resistant Coating: Non-sacrificial, non-glossy, colorless, penetrating, water-vapor-permeable, non-yellowing, that dries invisibly leaving appearance of substrate unchanged.
 - 1. Applications: All applicable vertical surfaces up to 12 feet above finish grade and non-traffic horizontal surfaces.
 - 2. Minimum Number of Coats: Two.
 - 3. No intentionally added cadmium.
 - 4. VOC Content: As specified in Section 01 61 16.
 - 5. Moisture Absorption When Applied to Masonry: 5 percent, maximum, when tested in accordance with ASTM C140/C140M using masonry sample completely coated with graffiti-resistant coating.
 - 6. Maintains dry appearance when wetted.
 - 7. Products (or equal): Water-based acrylic
 - a. Monopole, Inc.; Permanent Graffiti Control:
 - 1) Permashield Base 6100.
 - 2) Permashield Premium 5600 (Top Coat - Matte Finish).
 - 3) Cleaner: Citrus Clean Super - 9800
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 8. Compatibility: Anti-Graffiti coating shall be compatible with all standard paintable polymer type caulking and sealing materials and certified by manufacturer as suitable for use.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify joint sealants are installed and cured.
- C. Verify surfaces to be coated are dry, clean, and free of efflorescence, oil, or other matter detrimental to application of graffiti-resistant coating.

3.02 PREPARATION

- A. Protection of Adjacent Work:
 - 1. Protect adjacent landscaping, property, and vehicles from drips and overspray.
 - 2. Protect adjacent surfaces not intended to receive graffiti-resistant coating.
- B. Prepare surfaces to be coated as recommended by graffiti-resistant coating manufacturer for best results.
 - 1. Graffiti-Resistant coating over paint.
 - a. Primer as recommended by manufacturer of coating. Paint cure time as recommended by paint manufacturer prior to coating.

2. Graffiti-Resistant coating over unsealed concrete, brick, stucco, stone or block masonry units.
 - a. Provide compatible water repellent sealer as indicated in Section 07 19 00 - Water Repellents, as recommended by manufacturer.
3. Graffiti-Resistant coating over substrates or finishes not mentioned above.
 - a. Consult manufacturer for recommendations.
- C. Do not start work until masonry mortar substrate is cured a minimum of 60 days.
- D. Remove oil and foreign substances with a chemical solvent that will not affect graffiti-resistant coating.
- E. Allow surfaces to dry completely to degree recommended by graffiti-resistant coating manufacturer before starting coating work.

3.03 APPLICATION

- A. Apply at rate recommended by manufacturer, continuously over entire surface.
- B. Apply two coats, minimum.
- C. Remove graffiti-resistant coating from unintended surfaces immediately by a method instructed by graffiti-resistant coating manufacturer.
- D. Provide manufacturer's field service representative to inspect preparation and application work continuously during entire application period to ensure that manufacturer's "best practices" for preparation and application are being followed.

END OF SECTION

SECTION 10 11 00 VISUAL DISPLAY UNITS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Porcelain enamel steel markerboards. MB-1
- B. Tackable wall panels. TWP-1, TWP-2, TWP-3, & TWP-4.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- B. Section 09 21 16 - Gypsum Board Assemblies: Concealed supports in metal stud walls.

1.03 REFERENCE STANDARDS

- A. ANSI A208.1 - American National Standard for Particleboard.
- B. ASTM A424/A424M - Standard Specification for Steel, Sheet, for Porcelain Enameling.
- C. ASTM C208 - Standard Specification for Cellulosic Fiber Insulating Board.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- E. ASTM F793/F793M - Standard Classification of Wall Coverings by Use Characteristics.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's data on porcelain enamel steel markerboard, tackboard, tackboard surface covering, trim, and accessories.
- C. Shop Drawings: Indicate wall elevations, dimensions, joint locations , special anchor details.
- D. Samples: Color charts for selection of color and texture of porcelain enamel steel markerboard, tackboard, tackboard surface covering, and trim.
- E. Test Reports: Show compliance to specified surface burning characteristics requirements.
- F. Manufacturer's printed installation instructions.
- G. Manufacturer's Qualification Statement.
- H. Maintenance Data: Include data on regular cleaning, stain removal .

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year warranty for markerboard to include warranty against discoloration due to cleaning, crazing or cracking, and staining.

PART 2 PRODUCTS

2.01 VISUAL DISPLAY UNITS

A. Porcelain Enamel Steel Markerboards:

1. MB-1 Basis of Design Product: Dimension Hover as manufactured by Claridge Products and Equipment, Inc, or approved equal.
2. Color: White.
3. Steel Face Sheet Thickness: 24 gauge, 0.0239 inch .
4. Core: Particleboard, manufacturer's standard thickness, laminated to face sheet.
5. Backing: Aluminum foil, laminated to core.
6. Size: As indicated on drawings.
7. Frame: Extruded aluminum , with concealed fasteners.
8. Frame Profile: As indicated on drawings.
9. Frame Finish: Anodized, natural.
10. Accessories: Provide marker tray, map rail, and flag holder.

B. Tackable Wall Panels: Fabric laminated to fiberboard; Factory-fabricated.

1. Manufacturers:
 - a. TWP-1, TWP-2, TWP-3, & TWP-4.Basis of Design Product: Alphasorb Tackable Acoustic Panel as manufactured by Acoustical Solutions, or approved equal.
 - b. Alternate: TWP-1, TWP-2, TWP-3, & TWP-4.Basis of Design Product: Solid, 24mm as manufactured by Acoustical Solutions, or approved equal.
 - c. A-1 Visual Systems Co.: www.a-1visualsystems.com.
 - d. ABC School Equipment: www.abcse.com.
 - e. ADP Lemco, Inc: www.adplemco.com/#sle.
 - f. Chatfield-Clarke; Vinyl Tackboard Panels: www.chafield-clarke.com.
 - g. Claridge Products and Equipment, Inc; 3400 Series: www.claridgeproducts.com/#sle.
 - h. Lamvin Inc.; Tackboard Panels: www.lamvin.com.
 - i. Nelson Adams NACO: www.nelsonadamsnaco.com/#sle.
 - j. Substitutions: See Section 01 60 00 - Product Requirements.
2. Fabric: Vinyl-coated fabric.
3. Color, Pattern, and Texture: As selected from manufacturer's full range.
4. Backing: Fiber board, 7/8 inch thick, laminated to tack surface.
5. Surface Burning Characteristics: Flame spread index of 25, maximum, and smoke developed index of 450, maximum, when tested in accordance with ASTM E84.
6. Panel Width: As indicated on drawings.
7. Height: Full height of room or wall; No horizontal seams.
8. Length: As indicated on drawings.
9. Edge Treatment: Square edge unless detailed otherwise.

10. Edge Molding: Provide metal "J-mold" type edge trim for exposed edges at door and window openings and similar conditions.
11. TR-2 Trim: Satin natural anodized extruded aluminum, style and dimensions to suit application, for setting using tile mortar or adhesive.
12. Adhesives: Provide manufacturer's recommended adhesive, primer, and sealer, produced for use on substrate shown on drawings. Provide materials which are mildew-resistant and non staining to wallcovering.
- C. Combination Units and Units Made of More Than One Panel: Factory-assembled markerboards in a single frame, of materials specified above.
 1. Join panels of similar construction with butt joints, aligned and secured with steel spline concealed in edge of core.
 2. Configuration: As indicated on drawings.
 3. Units Too Large to Ship Assembled: Fully assembled in factory, then disassembled for shipping.

2.02 MATERIALS

- A. Porcelain Enameled Steel Sheet: ASTM A424/A424M, Type I, Commercial Steel, with fired-on vitreous finish.
- B. Vinyl-Coated Fabric: ASTM F793 Category VI.
- C. Particleboard: ANSI A208.1; wood chips, set with waterproof resin binder, sanded faces.
- D. Fiber Board: ASTM C208, cellulosic fiber board.
- E. Foil Backing: Aluminum foil sheet, 0.005 inch thick.
- F. Adhesives: Type used by manufacturer.

2.03 ACCESSORIES

- A. Map Rail: Extruded aluminum, manufacturer's standard profile, with cork insert and runners for accessories; 1 inch wide overall, full width of frame.
- B. Map Supports: Formed aluminum sliding hooks and roller brackets to fit map rail.
- C. Temporary Protective Cover: Sheet polyethylene, 8 mil thick.
- D. Flag Holders: Cast aluminum bored to receive 1 inch diameter flag staff, bracketed to fit top rail of board.
- E. Cleaning Instruction Plate: Provide instructions for chalkboard cleaning on a metal plate fastened to perimeter frame near chalkrail.
- F. Marker Tray: Aluminum, manufacturer's standard profile, one piece full length of markerboard, molded ends, concealed fasteners, same finish as frame.
- G. Mounting Brackets: Concealed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that internal wall blocking is ready to receive work and positioning dimensions are as indicated on shop drawings.

3.02 PREPARATION

- A. Acclimatize tackable wall panels by removing from packaging in installation area not less than 24 hours before application.
- B. Remove switchplates, wall plates, and surface-mounted fixtures where tackable wall paneling is applied. Reinstall items on completion of installation.
- C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.03 INSTALLATION

- A. Install boards in accordance with manufacturer's instructions.
- B. Install with top of marker tray at 30 inches above finished floor.
- C. Secure units level and plumb.
- D. Butt Joints: Install with tight hairline joints.
- E. Carefully cut holes in boards for thermostats, wall switches, and outlets.
- F. Install tackable wall panels in accordance with manufacturer's recommendations on specified substrates with concealed attachments.
 - 1. Fabricate re-wrapped edges where partial panels abut each other, or adjacent surfaces or trim.
 - 2. Re-wrap top, bottom or side edges for cutting panels around door or window openings, abutting trim, protruding objects, and at other openings, including x-cut at receptacles, light switches, and other openings.
 - a. Wrap minimum 2 inches around back of panel.
 - b. Carefully cut fiber board, leaving vinyl wallcovering intact. Wrap wallcovering tightly around edge of board and adhere continuously around back of panel with manufacturer's recommended vinyl wallcovering adhesive.

3.04 CLEANING

- A. Clean board surfaces in accordance with manufacturer's instructions.
- B. Cover with protective cover, taped to frame.
- C. Remove temporary protective cover at Final Inspection.

END OF SECTION

SECTION 10 11 46 PRESENTATION DRY ERASE WALLCOVERING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dry Erase Wallcovering.
- B. Magnetic Receptive Dry Erase Wallcovering. MB-2
- C. Pigmented Dry Erase Wallcovering.
- D. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 01 78 00 - Closeout Submittals: Project record documents, operation and maintenance (O&M) data, warranties and bonds.
- C. Section 09 21 16 - Gypsum Board Assemblies: Wall substrate and surface preparation.
- D. Section 09 91 23 - Interior Painting: Preparation and priming of substrate surfaces.
- E. Section 10 11 00 - Visual Display Units: Markerboards and tackboards.
- F. Division 26 - Electrical: Interior Lighting.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. GA-214 - Levels of Finish for Gypsum Panel Products.
- C. GA-216 - Application and Finishing of Gypsum Panel Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of dry erase wallcovering with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's product data and installation instructions for each type of dry erase wallcovering, adhesive, and accessories required.
- C. Samples: Submit two samples of the dry erase wallcovering, 7 x 9 inch in size, illustrating each dry erase material required.
- D. Certificate: Certify that products of this section meet or exceed specified requirements.
- E. Manufacturer's Instructions: Provide written installation instructions.
- F. Maintenance Data: Manufacturer's written instructions for recommended maintenance of each type of dry erase wall covering required.

- G. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in District's name and registered with manufacturer.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products by the same manufacturer.
- B. Installer Qualifications: Company specializing in performing the work of this section with minimum three years of experience.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 MOCK-UP

- A. Field Samples: Prepare field samples for Architect's review and establish requirements for seaming and finish trim.
 - 1. Locate where directed.
 - 2. Install sample panel of each type presentation wallcovering specified in area designated by Architect.
 - 3. Maintain corrected and approved samples to serve as a standard of performance for the project.
- B. Mock-up may remain as part of the Work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in unopened packaging until ready for installation.
 - 1. Clearly label with the manufacturer's identification label, quality or grade, and lot number.
- B. Store components under a dry covered area and elevated above grade.
 - 1. Maintained temperature above 55°F (13°C) with normal humidity.
 - 2. Store material within original packaging to prevent damage.

1.09 FIELD CONDITIONS

- A. Ambient Conditions: Do not install wallcoverings when surface and ambient temperatures are outside the temperature ranges required by the wallcovering manufacturer.
 - 1. Maintain continuous ventilation and heating facilities to maintain substrate surface and ambient temperatures above 55°F (13°C) during and after installation. Unless required otherwise by manufacturer's instructions
- B. Apply adhesive when substrate surface temperature and ambient temperature is above 55°F (13°C) and relative humidity is below forty percent.
- C. Maintain constant recommended temperature and humidity for at least 72 hours prior to and throughout the installation period, and for 72 hours after wallcovering installation completion.
- D. Provide not less than 80-foot-candles per square foot lighting level measured mid-height at substrate surfaces.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for manufacturing defects.

PART 2 PRODUCTS

2.01 BASE BID MANUFACTURER

- A. Basis of Design Product: Walltalkers by RJF International Corporation, Division of Koroseal: www.walltalkers.com.
- B. Other Acceptable Manufacturers:
 - 1. None identified
 - 2. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 SYSTEM

- A. Description:
 - 1. Composition:
 - a. MB-2 mag•rite® II: Scrim backed, ferrous powder, pigmented vinyl capped with dry erase film.
 - 2. Color: To be selected by Architect from full range.

2.03 MATERIALS

- A. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 450 or less, when tested in accordance with ASTM E84.
- B. Walltalkers mag•rite II: Magnetic receptive, moderate gloss vinyl surface for dry erase markers.
 - 1. M248: 47/48 inch (1.19/1.22m) width, woven backing.

2.04 ACCESSORIES

- A. Adhesives: Heavy-duty clear or clay based premixed vinyl adhesive.
- B. Substrate Primer/Sealer: White pigmented acrylic base primer/sealer specifically formulated for use with vinyl wallcoverings.
- C. Presentation Starter Kit: Provide for each room, one Walltalkers starter kit containing eight dry erase markers, one eraser, two dry erase cleaning cloths, one empty bottle for water, and one 8 ounce (.23kg) bottle liquid surface cleaning solution for each room installed with dry erase wallcovering.
 - 1. RK1RSK2: Regular starter kit with standard dry erase markers.
- D. Broad Tip Dry Erase Markers:
 - 1. EC12-99: Chisel BLK - 12CT
 - 2. EC04-00: Set of four colors: red, blue, green, black.
- E. Eraser:
 - 1. DEFE-99: Dry erase felt eraser.
 - 2. DECC-Y1: Dry erase cleaning cloth - yellow.

- F. Liquid Surface Cleaner:
 - 1. RCC8: 8 ounce (.23kg) bottle liquid surface cleaner.
- G. Magnets:
 - 1. MAG1: Heavy duty magnet - black.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine substrates and installation conditions to ensure surface conditions meet or exceed a Level 4 finish, per GA-214: Recommended Levels of Gypsum Board Finish, and permanent lighting should be installed and operational in compliance with GA-216.
- B. Test substrate with suitable moisture meter and verify that moisture content does not exceed four percent.
- C. Verify substrate surface is clean, dry, smooth, structurally sound, and free from surface defects and imperfections that would show through the finished surface.
- D. Evaluate all painted surfaces for the possibility of pigment bleed-through.
- E. Notify the contractor and architect in writing of any conditions detrimental to the proper and timely completion of the installation.
- F. Beginning of installation means acceptance of surface conditions.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Wallcovering backing.
 - 1. Acclimate wallcovering in the area of installation a minimum of 24 hours before installation.
 - 2. Read and follow the manufacturer's installation instruction sheet contained in each roll of the dry erase wallcovering.
 - 3. Examine all materials for pattern, color, quantity and quality, as specified for the correct location prior to cutting.
 - 4. Primer: Use a quality pigmented acrylic wallcovering primer.
 - 5. Adhesive: Apply a uniform coat of heavy-duty pre-mixed clay-based or extra strength clear wallcovering adhesive.
 - 6. Install each strip horizontally and in the same sequence as cut from the roll.
 - 7. Install dry erase wallcovering sheets in exact order as they are cut from bolt. Reverse hang alternate strips (except lined products). Do not crease or bend the wallcovering when handling.
 - 8. Install dry erase wallcovering horizontally using a level line.
 - 9. Using a level or straight edge, double cut the seam with a seam-cutting tool
 - a. (Ex: Double Seam-Cutter or Swedish Knife). Do not score drywall or plasterboard when cutting material.
 - 10. When covering the entire wall, seam the material out of the main writing and viewing areas of the wall.

11. Apply wallcovering to the substrate using a wallcovering smoother, wrapped with a soft cloth, to remove air bubbles. Do not use sharp edged smoothing tools. Smooth material on the wall from the middle to the outside edge.
 12. Remove excess adhesive immediately after the wallcovering is applied. Clean entire surface with a warm mild soap solution, and clean soft cloths. Rinse thoroughly with water and let dry before using. Change water often to maintain water clarity.
 13. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.
- C. Self-adhesive backing.
1. Walltalkers adhesive backed dry erase wallcovering is only recommended for use on surfaces impervious to moisture such as chalkboards, marker boards, glass, high-pressure laminates, or similar.
 2. Acclimate wallcovering in the area of installation a minimum of twenty-four hours before installation.
 3. Examine all materials for color, quantity, and quality as specified for the correct location prior to cutting.
 4. Read and follow the instructions in the manufacturer's installation sheet contained in each roll of the dry erase wallcovering.
 5. Do not crease or bend the wallcovering when handling.
 6. To allow air bubble removal, use a pump spray bottle to dampen the surface to be covered.
 - a. Dampening solution = one half to one capful of mild detergent to 1 gallon (1.81kg) clean water.
 7. Slowly remove release liner and smooth wall covering to the hanging surface using a wallcovering smoother wrapped with a soft cloth from the middle to the outside edge to remove air bubbles.
 8. Stop installation of material that is questionable in appearance and notify the manufacturer's representative for an inspection.

3.03 CLEANING

- A. Upon completion of installation, remove all exposed adhesive immediately using a soft cloth and a warm, mild soap solution and rinse thoroughly with water and dry with clean towel prior to using.
- B. Upon completion of the work, remove surplus materials, rubbish, and debris resulting from the wallcovering installation. Leave areas in neat, clean, and orderly condition.

3.04 MAINTENANCE

- A. See Section 01 7000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Maintenance instructions: Include precautions against cleaning materials and methods that may be detrimental to finishes and performance.

END OF SECTION

SECTION 10 14 16 PLAQUES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Plaques.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of plaque sign, indicating style, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings: Indicate dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
- D. Samples: One sample of each type of plaque sign, of size similar to that required for project, indicating style, font, and method of attachment.
- E. Selection Samples: Where materials, colors, and finishes are not specified, submit two sets of color selection charts or chips.
- F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package plaque signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Plaques:
 - 1. ARK Ramos Architectural Signage: www.arkramos.com.
 - 2. Best Sign Systems, Inc.: www.bestsigns.com.
 - 3. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
 - 4. Gemini Inc.: www.geminimade.com.
 - 5. Takeform: www.takeform.net/#sle.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and ICC A117.1 and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 PLAQUES

- A. Dedication Plaque: Provide on 30 inch square cast bronze dedication plaque containing information obtained from District and including the following:

1. SCHOOL NAME
2. BOARD MEMBERS (List names and Titles)
3. SUPERINTENDENT'S NAME
4. CABINET STAFF (List five names and Titles)
5. LOGO (To be provided)
6. ARCHITECT'S NAME
- CONTRACTOR
7. DATE

- B. Metal Plaques:

1. Material: Aluminum casting.
2. Material Thickness: 1/8 inch, minimum.
3. Size: As indicated on drawings.
4. Text and Typeface:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper case only.
 - c. Character Color: Contrast with background color.
5. Border Style: As indicated on drawings.
6. Background Texture: Leatherette.
7. Surface Finish: Brushed, satin.
8. Painted Background Color: Light oxide stain.
9. Protective Coating: Manufacturer's standard clear coating.
10. Mounting: As indicated on drawings.
 - a. Rosette Style: Floral.
 - b. Rosette Diameter: 1/2 inch.

2.04 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.
- B. Exposed Screws: Solid brass.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate plaque signs and mount at heights indicated on drawings and in accordance with ADA Standards and CBC Ch. 11B.
- D. Protect from damage until mm-dd-yyyy; repair or replace damaged items.

END OF SECTION

SECTION 10 14 19 DIMENSIONAL LETTER SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Dimensional letter signage.

1.02 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- C. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of dimensional letter sign, indicating style, font, colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
- D. Samples: Submit one sample of each type of dimensional letter sign of size similar to that required for project, indicating sign style, font, and method of attachment.
- E. Verification Samples: Submit samples showing colors and finishes specified.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- G. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package dimensional letter signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Dimensional Letter Signs:

1. Basis of Design Product: Individual Cast Metal Dimensional Letters as manufactured by Gemini, or approved equal.
2. ASI Sign Systems, Inc.: www.asisignage.com.
3. Cosco Industries; Cast Aluminum: www.coscoarchitecturalsigns.com.
4. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
5. Gemini, Inc.: geminimade.com.
6. Inpro Corporation: www.inprocorp.com/#sle.
7. Metallic Arts: www.metallicarts.com
8. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards and CBC Chapter 11B, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.03 DIMENSIONAL LETTERS

- A. Applications: Building identification.
 1. Use individual metal letters.
 2. Mounting Location: Exterior as indicated on drawings.
- B. Metal Letters:
 1. Material: Aluminum casting.
 2. Thickness: 1/8 inch minimum.
 3. Letter Height: As indicated on drawings.
 4. Text and Typeface:
 - a. Character Font: Gurindam.
 5. Finish: As selected by Architect from manufacturer's full range.
 6. Color: As selected.
 7. Mounting: Concealed screws.

2.04 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel or galvanized steel.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate dimensional letter signs and mount at heights indicated on drawings and in accordance with ADA Standards, CBC Chapter 11B, and applicable building codes.

- D. Protect from damage until final inspection; repair or replace damaged items.

END OF SECTION

SECTION 10 14 23 PANEL SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Panel signage.
- B. Traffic and parking control, and site informational signage

1.02 REFERENCE STANDARDS

- A. 29 CFR 1910.145 - Accident Prevention Signs and Tags; Current Edition.
- B. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- D. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2023.
- E. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2023.
- F. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- G. CBC - California Building Code; Current Adopted Edition.
- H. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- I. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.
- J. FED-STD-595C - Colors Used in Government Procurement (Fan Deck).; 2008 (Chg Notice 1).
- K. NFPA 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response; 2022.
- L. SAE AMS-STD-595A - Colors Used in Government Procurement; 2021.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's product literature for each type of panel sign, indicating styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings:
 - 1. Include dimensions, locations, elevations, materials, text and graphic layout, attachment details, and schedules.
 - 2. Schedule: Provide information sufficient to completely define each panel sign for fabrication, including room number, room name, other text to be applied, sign and letter sizes, fonts, and colors.
 - a. When room numbers to appear on signs differ from those on drawings, include the drawing room number on schedule.
 - b. When content of signs is indicated to be determined later, request such information from District through Architect at least 2 months prior to start of fabrication; upon request, submit preliminary schedule.
 - c. Submit for approval by District through Architect prior to fabrication.
- D. Samples: Submit two samples of each type of sign, of size similar to that required for project, indicating sign style, font, and method of attachment.

- E. Verification Samples: Submit samples showing colors, materials, and finishes specified.
- F. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- G. Manufacturer's qualification statement.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package signs as required to prevent damage before installation.
- B. Package room and door signs in sequential order of installation, labeled by floor or building.
- C. Store under cover and elevated above grade.
- D. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Panel Signage:
 - 1. ASI Sign Systems, Inc.: www.asisignage.com.
 - 2. Best Sign Systems, Inc: www.bestsigns.com/#sle.
 - 3. FASTSIGNS International, Inc: www.fastsigns.com/#sle.
 - 4. Inpro Corporation: www.inprocorp.com/#sle.
 - 5. Mohawk Sign Systems, Inc: www.mohawksign.com/#sle.
 - 6. Seton Identification Products: www.seton.com/aec/#sle.
 - 7. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.02 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards, CBC Chapter 11B, and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.
 - 1. Requirements for Persons with Disabilities: Provide identifying devices meeting the requirements for persons with disabilities of the following codes:
 - a. California Building Code (CBC) Title 24, Part 2; Chapter 11B, Accessibility.
 - b. Code of Federal Regulations 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities.
 - c. Accessible Means of Egress Signage: CBC 1009.
 - 1) Directional Signage: CBC 1009.10.

- (a) Provide directional signage complying with CBC Ch. 11B-703.5 indicating the location of all other means of egress and which are accessible means of egress:
 - (1) At exits serving a required accessible space but not providing an approved accessible means of egress.
- 2. Raised characters: Comply with CBC Ch. 11B-703.2.
 - a. Depth: It shall be 1/32 inch minimum above their background and shall be sans serif uppercase and be duplicated in Braille.
 - b. Height: It shall be 5/8 inch minimum and 2 inches maximum based on the height of the uppercase letter "I". CBC Ch. 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 Ch. 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 Ch. 11B-703.2.4 and 11B-703.2.6; If characters are both visual and raised, provide stroke width min. 10% and maximum 15% of the character "I". CBC Ch. 11B 703.5.7.
 - e. Character Spacing: Spacing between individual tactile characters shall comply with CBC Ch. 11B-703.2.7.
 - 1) 11B-703.2.8 Line spacing. Spacing between the baselines of separate lines of raised characters within a message shall be 135 percent minimum and 170 percent maximum of the raised character height.
 - f. Format: Text shall be in a horizontal format. CBC Ch. 11B-703.2.9.
 - g. Braille: It shall be contracted (Grade 2) and shall comply with CBC Ch. 11B-703.3 and 11B-703.4. Braille dots shall have a domed and rounded shape and shall comply with CBC Table and Figure 11B-703.3.1. Duplicate all characters on sign.
 - h. Mounting height: Tactile sign on signs shall be located 48 inches minimum to the baseline of the lowest Braille cells and 60 inches maximum to the baseline of the highest line of raised characters above the finish floor or ground surface. CBC Ch. 11B and Figure 11B-703.4.1.
 - i. Mounting location: A tactile sign shall be located per CBC Ch. 11B and Figure 11B-703.4.2 as follows:
 - 1) alongside a single door on the latch side.
 - 2) on the inactive leaf of a double door with one active leaf.
 - 3) to the right of the right hand door at double doors with two active leaves.
 - 4) 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.
 - 5) so that a clear floor space of 18 x 18 inch minimum, centered on the tactile characters, is beyond the arc of any door swing between the closed position and 45 degree open position.
- 3. Visual characters shall comply with CBC Ch. 11B -703.5 and shall be 40 inches minimum above finish floor or ground.
 - a. Visual character stroke thickness of the uppercase letter "I" shall be 10% minimum and 20% maximum of the height of the character. CBC Ch. 11B-703.5.7.

- 1) Line Spacing between the baselines of characters within a message shall be 135% minimum and 170% maximum of the character height per CBC Ch. 11B-703.5.9.
- 2) Character Spacing between individual adjacent characters shall be 10% minimum and 35% maximum of character height per CBC Ch. 11B-703.5.8.
4. Pictograms shall comply with CBC Ch. 11B-703.6.
5. Symbol of accessibility shall comply with CBC Ch. 11B-703.7.
6. Variable message signs shall comply with CBC Ch. 11B-703.8.

2.03 PANEL SIGNAGE

A. Panel Signage:

1. Application: Room and door signs.
2. Description: Flat signs with engraved panel media, tactile characters.
3. Sign Size: As indicated on drawings.
4. Total Thickness: 1/8 inch.
5. Sign Edges: Squared.
6. Letter Edges: Squared.
7. Corners: Squared.
8. Color and Font, unless otherwise indicated:
 - a. Character Font: Helvetica, Arial, or other sans serif font.
 - b. Character Case: Upper and lower case (title case).
 - c. Background Color: As scheduled.
 - d. Character Color: Contrasting color.
9. Material: Laminated colored plastic engraved through face to expose core as background color.
10. Profile: Flat panel in aluminum frame.
 - a. Frame Finish: Black anodized.
 - b. Clear Cover: For customer produced sign media, provide clear cover of polycarbonate plastic, glossy on back, nonglare on front.
11. Tactile Letters: Raised 1/32 inch minimum.
12. Braille: Grade II, ADA-compliant.
13. One-Sided Wall Mounting: Concealed screws.

2.04 SIGNAGE APPLICATIONS

A. Room and Door Signs:

1. Office Doors: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section for replaceable occupant name.
2. Conference and Meeting Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings; provide "window" section with sliding "In Use/Vacant" indicator.
3. Service Rooms: Identify with room names and numbers to be determined later, not those indicated on drawings.

4. Rest Rooms: Identify with pictograms, the names "MEN" and "WOMEN", room numbers to be determined later, and braille.
 - a. Identify all single user toilet facilities as gender neutral facilities by a door symbol that complies with CBC Ch. 11B-216.8 and 11B-703.7.2.6.3.
 - 1) No pictogram, text, or braille is required.
 - 2) Tactile jamb signage shall comply with appropriate technical requirements of CBC Ch. 11B-703.
 - (a) Examples of appropriate designations are "ALL-GENDER RESTROOM", "RESTROOM", or "UNISEX RESTROOM". DSA BU-17.
 - (b) Provide "RESTROOM" as the signage text, unless indicated otherwise on Drawings.
 - 3) See Drawings for actual sign to be provided.
 - b. Geometric Symbols: The symbol color shall contrast with door or wall.
 - 1) Comply with CBC Ch. 11B-216.8.1 at the entrances to toilet and bathing rooms.
 - 2) Comply with CBC Ch. 11B-703.7.2.6.
 - (a) Men's: An equilateral triangle, ¼ inch thick edges with edges 12 inches long and a vertex pointing upward.
 - (b) Women's: A circle, ¼ inch thick and 12 inches in diameter.
 - (c) Unisex (All Gender): A circle, ¼ inch thick and 12 inches in diameter with a equilateral triangle, ¼ inch thick edges with edges 12 inches long and a vertex pointing upward, superimposed on and geometrically inscribed within the circle and within the 12 inch diameter. The vertex of the triangle shall be located ¼ inch from the edge of the circle. The triangle shall contrast with the circle symbol, either light on a dark background or dark on a light background. The circle symbol shall contrast with the door.
 - (1) No pictogram is to be provided.
 - (d) Mount within 1 inch of the centerline of the door at minimum 58 inches and 60 inches maximum from the centerline of the symbol to the finished floor surface.- 5. Exits: Provide raised character and Braille exit signs per CBC Section 1013.4 at the following locations:

<u>Text</u>	<u>Location</u>
EXIT	Grade level exit door.
EXIT STAIR DOWN, EXIT STAIR UP	Exit door to exit stair.
EXIT RAMP DOWN, EXIT RAMP UP	Exit door to exit ramp.
EXIT ROUTE	Exit door to exit enclosure, exit passageway, exit corridor, or exit hallway.
TO EXIT	Exit door to horizontal exit.
EXIT WITH ALARM	Exit doors with an alarm.
EXIT ONLY or EXIT STAIR ONLY	Exit doors and stair exit doors which lock from outside and does not allow a return

B. Interior Directional and Informational Panel Signs:

1. Where suspended, ceiling mounted, or projecting from wall signs are indicated, provide two-sided signs with same information on both sides.

2. Assistive Listening Devices, include International Symbol of Access for Hearing Loss complying with CBC Ch. 11B Figure 11B-703.7.2.4..
 - a. Include International Symbol of Access for Hearing Loss, CBC Ch. 11B Figure 11B-703.7.2.4, with text "Assistive-Listening System Available". Use upper and lower case characters.
3. WHEELCHAIR LIFT SIGNS
 - a. Provide a sign in coordination with section 14 42 00 - Wheelchair Lifts, posted in a conspicuous place at each landing and within the platform enclosure stating 'NO FREIGHT' and include the International Symbol of Accessibility.
4. Occupant Load Signs:
 - a. Provide maximum occupancy load signs. Post in a conspicuous place near the main exit or exit access doorway from the room or space of rooms and areas indicated in the drawings.
 - b. Minimum size: 4 inches high by 8 inches wide, 7/8 inch high letters, 1 inch high numerals.
 - c. Sign to read: "MAXIMUM OCCUPANCY LOAD XXX". Indicate occupant load shown on drawings.
5. EMERGENCY GAS SHUT OFF SIGN
 - a. Exterior Signs: Painted aluminum, suitable for outdoor use, with pre-drilled mounting holes.
 - 1) Sign Size: Minimum 4 inches high by 8 inches wide.
 - 2) Color: Subsurface white text, red background.
 - 3) Character Height: One inch high.
 - 4) Text:
 - (a) Site main gas shut off valve(s): "Main Site Emergency Gas Shut-Off Valve".
 - (b) Building gas shut-off valve(s): "Building Emergency Gas Shut-Off Valve."
 - b. Science Lab and Kitchen Gas-Shut-Off Signs: 1/8 inch thick acrylic.
 - 1) Sign Size: Minimum 4 inches high by 8 inches wide.
 - 2) Color: Subsurface white text, red background.
 - 3) Character Height: One inch high.
 - 4) Text: "Emergency Gas Shut-Off Valve".
6. LADDER TO ROOF SIGN
 - a. 1/8 inch thick acrylic.
 - 1) Sign Size: Minimum 4 inches high by 8 inches wide.
 - 2) Color: Subsurface white text, red background.
 - 3) Character Height: One inch high.
 - 4) Text: "LADDER TO ROOF".
7. FIRE SPRINKLER RISER ROOM SIGN
 - a. Locate one sign at each fire sprinkler riser room door as indicated in drawings.
 - b. Text: Sign to read "Fire Sprinkler Riser Inside", white characters, 1 inch high on red background.
 - c. Sign Requirements:

- 1) Raised Characters and Proportions: Refer to Article 2.02.
 - 2) Braille: Refer to Article 2.02.
 - 3) Mounting Location and Height: Mounted on the door, Conform to CBC Ch. 11B.
- 8.
- C. Emergency Evacuation Map Panel Signs:
1. Allow for one map per elevator lobby.
 2. Map content to be provided by District.
- D. Traffic Signs: To match campus standards; locate where indicated on drawings.
1. Manufacturers:
 - a. Hawkins Traffic Safety Supply, Inc.: www.hawkinstraffic.com.
 - b. Safeway Sign Company: www.safewaysign.com.
 - c. Western Highway Products, Inc.: www.westernhighway.com.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 2. Plaque Signs: Provide manufacturer's standard silk-screened signs, baked-on enamel applied over Diamond Grade (DG), (10-year projected life) retro-reflectorized backing; on aluminum or 16 gage galvanized steel sheet. Provide with anti-graffiti protective overlay film. Produce smooth, even, level sign surfaces, constructed to remain flat under installed condition within a tolerance of plus or minus 1/16-inch measured diagonally. Provide two holes for post mounting.
 - a. Traffic Entry Warning Signs: Sign text, traffic and regular parking control shall comply with requirements of California Code of Regulations (CCR) Title 24, Part 2, Section 11B-502.6 and regulations of local governing authorities.
 - 1) Single post mount, not less than 17 x 22 inches with white reflectorized copy on blue background conforming to No. 15090, SAE AMS-STD-595A (FED-STD-595C), 2 inch high letters (1 inch high when less than 70 inches above finish surface, CBC Ch. 11B Table 703.5.5) to read as indicated on Drawings.
 - 2) Position sign in a conspicuous location immediately adjacent to each entrance to off-street parking facility or immediately adjacent to and visible from each stall or space.
 - 3) Sign shall be mounted 60 inches from bottom of sign to the adjacent finish grade when mounted on walls or fence; or 80 inches to pedestrian way or sidewalk or as shown on the drawings.
 - b. Parking Stall Signs: Sign text, accessible parking control shall comply with requirements of State of California Code of Regulations (CCR) - Title 24, Part 2, CBC Ch. 11B-502.6 in addition to requirements of State of California, Department of Transportation (CALTRANS) and regulations of local authorities having jurisdiction.
 - 1) Single post mount, not less than 70 square inches with white reflectorized copy on blue background conforming to No. 15090, SAE AMS-STD-595 (FED-STD-595C). Sign shall display a profile view of a wheelchair with occupant in white on blue background.
 - (a) Provide an additional sign below the accessible sign with the text "Minimum Fine \$250".
 - 2) Position one sign at the end of each parking space designated for disabled usage.

- 3) One in every six spaces (CBC Ch. 11B-208.2.4), but not less than one, provide a 12 inch by 3-1/4 inch "Van Accessible" sign below the symbol of accessibility, wording per CBC Ch. 11B-502.6, 36 CFR 1191, and ADA Standards.
- 4) Sign shall be mounted 80 inches from bottom of sign to finish grade of parking space or centered on wall at interior end of parking space at a minimum height of 60 inches above the parking space, finished grade, ground or sidewalk, to the bottom of the sign.
- c. Additional signs, with content as indicated on Drawings.
- d. Fire Lane Signs:
 - 1) Single post mount, of size, color and sign text as shown on site plan or as required by local codes and fire department authority.
 - 2) Quantity, location and mounting heights to be determined by local fire department authority.
- e. Fire Safety Signage:
 - 1) Provide sign, types, shapes, and content as indicated on Drawings and as required for products in-use, stored, and installed.
 - 2) Comply with OSHA 29 CFR 1910.145, NFPA 704, ANSI Z535.2, ANSI Z535.4, and California Fire Code.
3. Support Posts:
 - a. Galvanized steel pipe, minimum 2-1/2 inch diameter or as indicated, with caps.
 - b. Concrete: Ready-mixed, complying with ASTM C94/C94M; normal Portland cement; 3,500 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.
4. Accessories: Provide welded galvanized steel fittings and galvanized or stainless steel bolts, nuts and washers.
5. Fasteners: Provide tamper-proof galvanized steel fasteners.
 - a. Tufnut System (714) 962-5838, Allegheny Bolt (Tampruf brand; (516) 568-1052 or equal.

2.05 FABRICATION

- A. Provide signs and supports factory-prefabricated and pre-finished, ready for assembly and installation.

2.06 ACCESSORIES

- A. Concealed Screws: Noncorroding metal; stainless steel, galvanized steel, chrome plated, or other.
- B. Exposed Screws: Stainless steel.
- C. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION AT BUILDING

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate panel signs and mount at heights indicated on drawings and in accordance with ADA Standards, CBC Chapter 11B, and applicable building codes.
 - 1. Room and Door Signs: Locate on wall at latch side of door (per CBC Ch. 11B-703.4.2) a minimum of 48 inches to the baseline of the lowest braille cells; with baseline of highest line of raised character text at maximum 60 inches above finished floor.
 - a. Comply with CBC Ch. 11B-703.4.1 and CBC Ch. 11B -703.4.2
- D. Protect from damage until final inspection; repair or replace damaged items.

3.03 SITE AND TRAFFIC SIGN INSTALLATION

- A. Locate informational signage as verified in field by District. Verify and coordinate sign locations to prevent conflict with underground utilities.
- B. Locate accessible car and van parking stall and drive approach signs where shown on Drawings and as required by applicable ordinances and regulations of authorities having jurisdiction. Verify and coordinate sign locations to prevent conflict with underground utilities.
- C. Excavate for sign support footings to depth as shown on Drawings or, if not shown, as recommended by manufacturer. Provide forms for concrete not supported by compacted soil.
- D. Set posts in concrete base, minimum 12 inch diameter and 18 inches deep; unless indicated otherwise on Drawings.
 - 1. Set sign support post plumb and so sign face will be perpendicular to stall or parallel to curb face, as applicable.
 - a. Set posts into pipe sleeve inserts set and anchored into concrete.
 - b. Fill annular space between posts and sleeves with grouting compound.
 - 2. Signs set in asphaltic paving surfaces or concrete sidewalks shall be mounted in core drilled holes minimum 8 inch diameter, 18 inches deep with top of base flush to finish.
 - 3. Firmly attach signs mounted to walls with appropriate expansion anchors or bolting, adhesive not permitted.
 - 4. Seal all holes water tight.
- E. Install plaque signage to posts, with panel facing traffic as necessary.

3.04 FIELD QUALITY CONTROL

- A. Inspect signs for information content, appearance, location and Braille per as noted in Section 01 45 33 - Code-Required Special Inspections.
- B. Inspect signs for information content, appearance, location and Braille:
 - 1. Prior to issuance of a final Certificate of Occupancy, Enforcing Agency shall verify installation of signs for information content, appearance, location and Braille per CBC Ch. 11B-703.1.1.2.
 - a. Inspection includes, but not limited to:
 - 1) Braille dots and cells are properly spaced and the size proportion and type raised characters are in compliance with these regulations.

- 2) Sanitary facilities signage per CBC Ch. 11B-216.8 Toilet rooms and bathing rooms; and CBC Ch. 11B-703.7.2.6 Toilet and bathing facilities geometric symbols.
- 3) Tactile exit signage per CBC 1013.4 and CBC Ch. 11B-216.4.1 Exit doors.

3.05 ADJUST AND CLEAN

- A. Repair damage to signs incurred during installation. Replace signs which cannot be repaired to new condition. Clean glass, frames, and other sign surfaces, adjust hardware for proper operation.

END OF SECTION

SECTION 10 14 43 PHOTOLUMINESCENT SIGNAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Photoluminescent signs.

1.02 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM E2072 - Standard Specification for Photoluminescent (Phosphorescent) Safety Markings; 2014.
- C. CBC - California Building Code; Current Adopted Edition.
- D. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.
- E. NFPA 170 - Standard for Fire Safety and Emergency Symbols; 2021.
- F. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- G. UL 1994 - Luminous Egress Path Marking Systems; Current Edition, Including All Revisions.

1.03 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's printed product literature for each type of sign, indicating sign styles, font, foreground and background colors, locations, and overall dimensions of each sign.
- C. Shop Drawings: Indicate dimensions, locations, elevations, materials, text and graphic layout, and attachment details.
- D. Samples: Submit two samples of each type of photoluminescent sign, of size similar to that required for project, indicating style, font, and method of attachment.
- E. Manufacturer's Installation Instructions: Include installation templates and attachment devices.
- F. Manufacturer's qualification statement.

1.04 QUALITY ASSURANCE

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

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Package photoluminescent signs as required to prevent damage before installation.
- B. Store under cover and elevated above grade.
- C. Store tape adhesive at normal room temperature.

1.06 FIELD CONDITIONS

- A. Do not install tape adhesive when ambient temperature is lower than recommended by manufacturer.
- B. Maintain minimum ambient temperature during and after installation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Accessibility Requirements: Comply with ADA Standards, CBC Chapter 11B, and applicable building codes, unless otherwise indicated; in the event of conflicting requirements, comply with the most restrictive requirements.

2.02 PHOTOLUMINESCENT SIGNS

- A. Photoluminescent Signage for Floor Level Exit Signs at A and E Occupancies:
 - 1. Comply with CBC 1013.5 and 1013.7 Floor Level Exit Signs.
 - 2. Comply with NFPA 170, UL 1994, and ASTM E2072. Listing: UL 924.
 - 3. California State Fire Marshal Approval: Yes.
 - 4. Application: Directional.
 - 5. Size: 14.25 inches by 7.5 inches, Nominal.
 - 6. Thickness: 0.32 inch.
 - 7. Mounting: Wall mounted.
 - 8. Mounting Bracket: Anodized aluminum; Wall mount, dual facing where indicated on Drawings.
 - 9. Visibility Rating: 50 feet.
 - 10. Graphics: 6 inches high.
 - a. Comply with CBC 1013.6.1.
 - b. Letter color: Green with red outline.
 - 11. Symbol: Chevron.
 - 12. Material: Photoluminescent pigment on powder coated aluminum substrate.
 - 13. Vandal Resistant.
 - 14. Warranty: 30 Years.
 - 15. Products:
 - a. Basis of Design Product: Exit Sign, FRUL-050-B as manufactured by NightBright USA, nightbrightusa.com, or approved equal.
 - b. Active Safety; ECO-CLEAR Series 2003: www.activesafety.com.
 - c. ELCO Lighting; EE80S Self Illuminating Exit Sign (Green Letters): elcolighting.com.
 - d. Safe-T-Nose, LLC; Photoluminescent Exit Sign (EUL50): www.safetnose.com/#sle.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.03 ACCESSORIES

- A. Tape Adhesive: Double-sided tape, permanent adhesive.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.

- B. Notify Architect if conditions are not suitable for installation of signs; do not proceed until conditions are satisfactory.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install with horizontal edges level.
- C. Locate photoluminescent signs and mount at heights indicated on drawings and in accordance with ADA Standards, CBC Chapter 10, and CBC Chapter 11B.
- D. Protect from damage until final inspection; repair or replace damaged items.

END OF SECTION

SECTION 10 21 13.19 FRP/ALUMINUM TOILET COMPARTMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. FRP/Aluminum, plastic core toilet compartments.
- B. Urinal screens.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Concealed steel support members.
- B. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- C. Section 10 28 00 - Toilet Accessories.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines.
- B. ADA Standards - 2010 ADA Standards for Accessible Design.
- C. ASTM B209/B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- D. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
- E. ASTM D256 - Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
- F. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
- G. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
- H. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- I. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
- J. ASTM D1622 - Standard Test Method for Apparent Density of Rigid Cellular Plastics.
- K. ASTM D1623 - Standard Test Method for Tensile and Tensile Adhesion Properties of Rigid Cellular Plastics.
- L. ASTM D2126 - Standard Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
- M. ASTM D2583 - Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.
- N. ASTM D5116 - Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions From Indoor Materials/Products.
- O. ASTM D5420 - Standard Test Method for Impact Resistance of Flat, Rigid Plastic Specimen by Means of a Striker Impacted by a Falling Weight (Gardner Impact).
- P. ASTM D6607 - Standard Practice for Inclusion of Precision Statement Variation in Specification Limits.

- Q. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- R. CBC - California Building Code.
- S. CBC Ch. 11B - California Building Code-Chapter 11B.
- T. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work with placement of support framing and anchors in walls and ceilings.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on panel construction, hardware, and accessories.
 - 1. If other than specified manufacturer or specified product, submit catalog data.
- C. Shop Drawings: Indicate partition plan, elevation views, dimensions, details of wall supports, door swings.
 - 1. Show plan and elevation views for each room. Indicate types and thicknesses of materials and assemblies.
 - 2. Attachment details.
- D. Samples: Submit two samples of partition panels, 2 by 2 inch in size illustrating panel finish, color, and sheen.
- E. Manufacturer's Installation Instructions: Indicate special procedures.

1.06 WARRANTY

- A. All components shall have a 10 year limited warranty.

1.07 PACKAGING, DELIVERY, STORAGE AND HANDLING

- A. Packaging: Maintain factory packaging and protective coverings.
- B. Storage: Store panels to prevent impact and moisture damage.

1.08 PROJECT CONDITIONS

- A. Field Measurements: Verify field design and field dimensions before submitting shop drawings and before fabrication.
- B. Environmental Conditions: Maintain humidity and temperature in ranges required by manufacturer.

1.09 SEQUENCING AND SCHEDULING

- A. Complete tile and painting Work before toilet partition installations.
- B. Coordinate dimensions and locations of cut-outs and panel reinforcement with approved toilet accessories.
- C. Coordinate backing and blocking provisions in walls.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Code compliance of these systems must be verified prior to use. They may be no longer available and are not yet proven to be compliant with NFPA 286, per CBC Sections **803.1.2**, **803.11**, 2604.2.4.
- B. Installation shall meet requirements for the physically disabled of the California Code of Regulations (CCR) Title 24 Part 2 and latest amendments to the ADA Standards and 36 CFR 1191.
- C. California Building Code (CBC) disabled accessibility regulations.
 - 1. Wheelchair accessible compartment shall comply with CBC Ch. 11B-604.8.1.
 - 2. Toe clearance for at least one side partition of a wheelchair accessible compartment shall comply with CBC Ch. 11B Figure 604.8.1.4.
 - a. It shall be 9 inches high minimum above the finish floor and 6 inches deep minimum beyond the compartment side face of the partition, exclusive of partition support members.
 - b. It shall be 12 inches high minimum above the finish floor for children's use.
 - c. Partition components at toe clearances shall be smooth without sharp edges or abrasive surfaces.
 - d. Toe clearance is not required in a compartment greater than 66 inches wide.
 - 3. Ambulatory accessible compartments shall be provided where there are six or more toilet compartments, or where the combination of urinals and water closets totals six or more fixtures.
 - a. Such compartment shall be provided in the same quantity as wheelchair accessible compartments per CBC Ch. 11B-213.3.1 and shall comply with CBC Ch. 11B-604.8.2.
 - 4. Door and door hardware for accessible compartments shall be self-closing and shall comply with CBC Ch. 11B-404 except that if the approach is on the latch side of an ambulatory compartment door, clearance between the door side of the compartment and any obstruction shall be 44 inches minimum. CBC Ch. 11B Figure 604.8.2.
 - 5. A door pull complying with CBC Ch. 11B-404.2.7 shall be placed on both sides of the accessible compartment door near the latch.
 - 6. Ambulatory Accessible Toilet Compartment doors shall not swing into the clear floor space or clearance required for any fixture or into the minimum required compartment area. CBC Ch. 11B-604.8.2.2.

2.02 FRP/ALUMINUM TOILET COMPARTMENTS

- A. TC-1 Basis of Design Product: SpecLite 3® FRP Bathroom Partitions as manufactured by Special-Lite, Inc, www.special-lite.com, or approved equal.
- B. FRP Toilet Compartments: Factory fabricated doors, pilasters, and divider panels made of FRP over a rigid cellular plastic core with aluminum trim, tested in accordance with NFPA 286; floor-mounted headrail-braced.
 - 1. Color: Single color as selected, in each space.
 - 2. Flame Spread Rating (ASTM E84):

- a. Class C flame spread 76-200 and smoke developed of 0-450.
3. Doors, Panels, and Pilasters: Standard panel edge.
 - a. Aluminum Perimeter Channel.
 - 1) Aluminum extrusions made from 6063 aluminum alloys with a minimum temper of T5.
 - 2) Minimum 1-3/4 inch deep one-piece extrusion with have integral reglets to accept face sheet on both interior and exterior side of panel which secure face sheet into place and permit flush appearance.
 - 3) Screw or snap in place applied caps are not acceptable.
 - b. Corners:
 - 1) Mitered.
 - 2) Mechanically fastened.
 - c. Core:
 - 1) Poured-in-place polyurethane foam.
 - 2) Laid in foam cores are not acceptable.
 - d. Face Sheet.
 - 1) Standard: 0.09 inch thick, pebble texture, through color with SpecLite 3® integral surfaseal film FRP sheet.
 - (a) Class C standard.
 - 2) Attachment of face sheet: Extruded panel perimeter frame to have integral reglets to accept face sheet on both sides of panel which secure face sheet into place and permit flush appearance.
 - (a) Use of glue to bond face sheet to core or extrusions is not acceptable.
4. Doors:
 - a. Thickness: 1-1/4 inch.
 - b. Width: 24 inch.
 - c. Width for Handicapped Use: 36 inch, out-swinging.
 - d. Height: 58 inch.
5. Panels:
 - a. Thickness: 1-1/4 inch.
 - b. Height: 58 inch.
 - 1) Provide minimum 9 inch high, foot clearance at accessible toilet stalls.
 - c. Depth: As indicated on drawings.
6. Pilasters:
 - a. Thickness: 1-1/4 inch.
 - b. Width: As required to fit space; minimum 3 inch, 1 inch increments up to 12 inches, 12 inches to 24 inches wide in 2 inch increments.
 - c. Standard Height: 80 inches.
7. Screens: Without doors; to match compartments; mounted to wall with continuous panel brackets.

- a. Aluminum heat sink fastened to bottom edges
- b. Urinal Screens: 24 inches wide by 42 inches high.
 - 1) Mount 14 inches above floor.

2.03 MATERIALS

- A. Aluminum Members: Sheet and plate to conform to ASTM B209/B209M.
 - 1. Aluminum extrusions made 6061 or 6063 aluminum alloys.
 - 2. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.

2.04 ACCESSORIES

- A. Pilaster Shoes: Anodized aluminum, 4 inches high; concealing floor fastenings.
 - 1. Provide adjustment for floor variations with screw jack through steel saddles integral with pilaster.
 - 2. Provide ceiling attachment using two adjustable hanging studs, attached to above-ceiling framing.
- B. Head Rails: Extruded aluminum, anti-grip profile.
 - 1. Size: Manufacturer's standard size.
- C. Wall and Pilaster Brackets: Anodized aluminum; continuous type.
 - 1. Standard: Full height "U-Shaped" aluminum brackets.
- D. Attachments, Screws, and Bolts: Stainless steel , tamper proof type.
 - 1. For attaching panels and pilasters to brackets: Through-bolts and nuts ; tamper proof.
 - 2. Secure to pilasters with a stainless steel tamper resistant Torx head sex bolt.
- E. Hinges: Anodized aluminum, manufacturer's standard finish.
 - 1. Continuous-type hinge, self closing.
 - 2. Optional: SL-64
- F. Door Hardware: Anodized aluminum, manufacturer's standard finish.
 - 1. Door Latch: Slide type with exterior emergency access feature.
 - a. Latch Mechanism: Stainless Steel Slide Bolt Latch and Housing: Heavy-duty stainless steel type 304. The latch and housing to have a bright finish. The slide bolt and button to have a black anodized finish.
 - b. Latch Mechanism: Occupancy Indicator Latch and Housing:
 - 1) Material: Satin stainless steel.
 - 2) Occupancy indicators: Green for occupied and red not occupied.
 - 3) Slide bolt and button.
 - 2. Door Strike and Keeper with Rubber Bumper: Mount on pilaster in alignment with door latch.
 - a. Heavy-duty extruded aluminum 6436-T5 alloy with a bright dip anodized finish. Secure to pilasters with stainless steel tamper resistant Torx head sex bolts. Bumper made of extruded black vinyl.
 - b. Style: 6 inches aluminum.

3. Provide second CBC Ch. 11B and ADA Standards door pull for outswinging doors at accessible doors.
 - a. Surface mounted U-shaped or wire pulls on both sides of accessible compartment doors.
 - b. Chrome Plated Double Door Pull 5-1/2", for 1 inch thick doors.
 - c. Overall width is 6-3/4 inches with 5-7/8 inch hole spacing.
- G. Coat Hook: One per compartment, mounted on door.
 1. Mount such that no portion is over 40 inches above finish floor , at accessible stall, and 48 inches above finish floor at non-accessible stall.

2.05 PERFORMANCE

A. Face Sheet.

1. Standard, Light Grey, Seawolf, Blue, Black, Slate Grey, Sage Brown, White, Desert Sand, Class C 0.09 inch thick, pebble texture, through color with SpecLite 3® integral surfaseal film FRP sheet.
 - a. Flexural Strength, ASTM D790: 16.4 x 103 psi.
 - b. Flexural Modulus, ASTM D790: 0.6 x 106 psi.
 - c. Tensile Strength, ASTM D6388: 12.0 x 103 psi.
 - d. Tensile Modulus, ASTM D638: 1.3 x 106 psi.
 - e. Barcol Hardness, ASTM D2583: 50.
 - f. Izod Impact, ASTM D256: 18.5 ft-lb/in.
 - g. Gardner Impact Strength, ASTM D5420: 100 in-lb.
 - h. Water Absorption, ASTM D570: 0.20%/24hrs at 77°F.
 - i. Surface Burning, ASTM E84: Flame Spread ≤ 200, Smoke Developed ≤ 450.
 - j. Chemical Resistance.
 - 1) Excellent Rating.
 - (a) Acetic Acid, Concentrated.
 - (b) Acetic Acid, 5%.
 - (c) Bleach Solution.
 - (d) Detergent Solution.
 - (e) Distilled Water.
 - (f) Ethyl Acetate.
 - (g) Formaldehyde.
 - (h) Heptane.
 - (i) Hydrochloric Acid, 10%.
 - (j) Hydrogen Peroxide, 3%.
 - (k) Isooctane.
 - (l) Lactic Acid, 10%.
 - k. USDA/FSIS Requirements.

- 1) FRP face sheet with SpecLite 3® integral surfaseal is a finished outer surface material that is rigid; durable; non-toxic; non-corrosive; moisture resistant; a light, solid color such as white; easily inspected; smooth or an easily cleaned texture.
 - 2) FRP face sheet with SpecLite 3® integral surfaseal does not contain any known carcinogen, mutagen, or teratogen classified as hazardous substances; heavy metals or toxic substances; antimicrobials; pesticides or substances with pesticidal characteristics.
- B. Panel Core.
1. Density, ASTM D1622: ≤ 5.0 pcf.
 2. Compressive Properties, ASTM D1621: Compressive Strength ≥ 60 psi, Compressive Modulus ≥ 1948 psi.
 3. Tensile and Tensile Adhesion Properties, ASTM D1623: Tensile Adhesion, 3" x 3" FRP Facers ≥ 53 psi, Tensile Adhesion, 1" x 1" Foam ≥ 104 psi.
 4. Thermal and Humid Aging, ASTM D2126: Volume Change at 158 °F, 100% humidity, 14 days $\leq 13\%$.
 5. Thermal Conductivity, ASTM C518, Thermal Resistance ≥ 0.10 m²K/W.
- C. Indoor Air Quality, ASTM D5116, ASTM D6607: GreenGuard, GreenGuard Gold.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify correct spacing of and between plumbing fixtures.
- C. Verify correct location of built-in framing, anchorage, and bracing.

3.02 INSTALLATION

- A. Install partitions secure, rigid, plumb, and level in accordance with manufacturer's instructions.
- B. Maintain 3/8 inch to 1/2 inch space between wall and panels and between wall and end pilasters.
- C. Attach panel brackets securely to walls using anchor devices.
- D. Attach panels and pilasters to brackets. Locate head rail joints at pilaster center lines.
- E. Field touch-up of scratches or damaged finish will not be permitted. Replace damaged or scratched materials with new materials.

3.03 TOLERANCES

- A. Alignment Tolerance: Plus or minus 1/16 inch, in any direction.
- B. Maximum Variation From True Position: 1/4 inch.
- C. Maximum Variation From Plumb: 1/8 inch.

3.04 ADJUSTING

- A. Operation: Doors shall operate smoothly and evenly.
- B. Adjust and align hardware to uniform clearance at vertical edge of doors, not exceeding 3/16 inch.

- C. Adjust hinges to position doors in partial opening position when unlatched. Return out-swinging doors to closed position.
 - 1. Adjust doors to remain open at approximately 30 degrees.
- D. Adjust adjacent components for consistency of line or plane.
- E. Field Operation and Alignment Check: Demonstrate compliance with specified tolerance and operation requirements.
 - 1. Should check reveal misalignment, improper operation or inadequate anchorage, realign, adjust and re-anchor the entire installation to Architect's satisfaction.
 - 2. Replace deformed, marred, damaged or dented parts at no change in Contract Time or Sum.

3.05 CLEANING

- A. Cleaning After Installation: Clean exposed surfaces of panel systems using materials and methods recommended by manufacturer.
- B. Protection: Provide protection as necessary to prevent damage during remainder of construction period.
- C. Final Cleaning: Clean partitions to dust-free condition prior to Final Acceptance.

END OF SECTION

SECTION 10 26 00 WALL AND DOOR PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Corner guards.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Blocking for wall and corner guard anchors.

1.03 REFERENCE STANDARDS

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Indicate physical dimensions, features, wall mounting brackets with mounted measurements, anchorage details, and rough-in measurements.
- C. Samples: Submit samples illustrating component design, configurations, joinery, color and finish.
 - 1. Submit two sections of corner guards, 12 inches long.
- D. Manufacturer's Instructions: Indicate special procedures, perimeter conditions requiring special attention.
- E. Maintenance Materials: Furnish the following for District's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
- F. Maintenance Data: Manufacturer's instructions for care and cleaning of each type of product. Include information about both recommended and potentially detrimental cleaning materials and methods.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver wall and door protection items in original, undamaged protective packaging. Label items to designate installation locations.
- B. Protect work from moisture damage.
- C. Protect work from UV light damage.
- D. Do not deliver products to project site until areas for storage and installation are fully enclosed, and interior temperature and humidity are in compliance with manufacturer's recommendations for each type of item.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.

PART 2 PRODUCTS

2.01 PRODUCT TYPES

- A. Corner Guards - Flush Mounted: CGD-1

1. Material: Powder coated aluminum. Drywall corner trim DMCT-375 by Fry Reglet.
 2. Width of Wings: 1-1/4 inches.
 3. Corner: Square.
 4. Color: As indicated on Drawings.
 5. Length: One piece.
- B. Adhesives and Primers: As recommended by manufacturer.
- C. Mounting Brackets and Attachment Hardware: Appropriate to component and substrate.
- D. See Section 06 10 00 for wood blocking for wall and corner guard anchors.

2.02 FABRICATION

- A. Fabricate components with tight joints, corners and seams.
- B. Pre-drill holes for attachment.

2.03 SOURCE QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Provide wall and door protection systems of each type from a single source and manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.
- B. Verify that field measurements are as indicated on drawings.
- C. Verify that substrate surfaces for adhered items are clean and smooth.
1. Test painted or wall covering surfaces for adhesion in inconspicuous area, as recommended by manufacturer. Follow adhesive manufacturer's recommendations for remedial measures at locations and/or application conditions where adhesion test's results are unsatisfactory.
- D. Start of installation constitutes acceptance of project conditions.

3.02 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to supporting construction.

3.03 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.
- B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

3.04 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- B. Clean wall and door protection items of excess adhesive, dust, dirt, and other contaminants.

END OF SECTION

SECTION 10 28 00 TOILET ACCESSORIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Commercial toilet accessories. GB-1, GB-2, MR-1, TTD-1/2, TSD-1, & WRC-1
- B. Under-lavatory pipe supply covers.
- C. Electric hand/hair dryers. HD-1
- D. Utility room accessories.
- E. Some items are District Furnished and Contractor Installed (OFCI). Accessories and installation materials are the responsibility of the Contractor.
- F. Some items are District Furnished and District Installed (OFOI). Contractor to coordinate installation with related and adjacent work.

1.02 RELATED REQUIREMENTS

- A. Section 10 21 13.19 - Plastic Toilet Compartments.
- B. Section 22 40 00 - Plumbing Fixtures: Under-lavatory pipe and supply covers.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ASTM A269/A269M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
- C. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
- D. ASTM B456 - Standard Specification for Electrodeposited Coatings of Copper Plus Nickel Plus Chromium and Nickel Plus Chromium.
- E. ASTM C1036 - Standard Specification for Flat Glass.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass.
- G. ASTM C1503 - Standard Specification for Silvered Flat Glass Mirror.
- H. CBC Ch. 11B - California Building Code-Chapter 11B.
- I. DSA IR 16-12 - Grab Bar Design and Connections.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with the placement of internal wall reinforcement, concealed ceiling supports, and reinforcement of toilet partitions to receive anchor attachments.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit data on accessories describing size, finish, details of function, and attachment methods.

- C. Manufacturer's Installation Instructions: Indicate special procedures and conditions requiring special attention.
- D. Maintenance Materials: Furnish the following for District's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Tools: One each of every special tool required for maintenance of fasteners and operable parts.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Provide toilet accessories meeting the requirements for the persons with disabilities of the California Building Code (CBC), Title 24 Part 2, CBC Ch. 11B, and 2010 ADA Standards, as amended.
- B. Accessible requirements:
 - 1. Elements of sanitary facilities shall be mounted at locations in compliance with CBC Ch. 11B-602 through 11B-612.
 - 2. Grab bars in toilet facilities and bathing facilities shall comply with CBC Ch. 11B-609.
 - a. Grab bars and any wall or other surfaces adjacent to grab bars shall be free of sharp or abrasive elements and shall have rounded edges.
 - b. The space around the grab bars shall be as follows:
 - 1) 1-1/2 inches between the grab bar and the wall. CBC Ch. 11B-609.3.
 - 2) 1-1/2 inches minimum between the grab bar and projecting objects below and at the ends.
 - 3) 12 inches minimum between the grab bar and projecting objects above.
 - 3. Toilet accessories required to be accessible shall be mounted with any operable part at maximum 40 inches above the finish floor. CBC Ch. 11B-603.5.
 - 4. The grab bar shall not project more than 3 inches into the 48 inches minimum clear space required in front of the water closet. CBC Ch. 11B-609.3.
 - 5. Toilet tissue dispensers are to be continuous flow type. CBC Ch. 11B-604.7.
 - 6. Toilet paper and feminine napkin disposals located on the grab bar side of the accessible toilet room or stall shall not project more than the grab bar or 3 inches from the finished wall surface nor be located closer than 1-1/2 inches clear of the tangent point of the grab bar. (Legacy DSA Interpretation.)
 - a. Accessories surface mounted above grab bar will restrict usability.
 - 7. All other accessories shall not project more than 4 inches from wall surface, but cannot encroach into any required clear space.
 - 8. Shower controls shall comply with CBC Ch. 11B-608.5.
 - 9. Shower seats shall comply with CBC Ch. 11B-610.3 Shower compartment seats.

2.02 MANUFACTURERS

- A. Commercial Toilet, Shower, and Bath Accessories:
 - 1. American Specialties, Inc: www.americanspecialties.com/#sle.
 - 2. Bobrick Washroom Equipment, Inc.: www.bobrick.com.

3. Bradley Corporation: www.bradleycorp.com/#sle.
 4. Gamco: www.gamcousa.com.
 5. Georgia-Pacific Professional: www.blue-connect.com/#sle.
 6. Kimberly-Clark Corporation; Kimberly-Clark Professional ICON Collection:
www.kcprofessional.com/#sle.
 7. Substitutions: Section 01 60 00 - Product Requirements.
- B. Electric Hand/Hair Dryers:
1. Dyson Inc; Dyson Airblade V: www.dyson.com/#sle.
 2. Substitutions: Section 01 60 00 - Product Requirements.
- C. Provide products of each category type by single manufacturer.

2.03 MATERIALS

- A. Accessories - General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
1. Grind welded joints smooth.
 2. Fabricate units made of metal sheet of seamless sheets with flat surfaces.
- B. Stainless Steel Sheet: ASTM A666, Type 304.
- C. Stainless Steel Tubing: ASTM A269/A269M, Grade TP304 or TP316.
- D. Mirror Glass: Annealed float glass, ASTM C1036 Type I, Class 1, Quality Q2, with silvering, protective and physical characteristics complying with ASTM C1503.
- E. Mirror Glass: Tempered safety glass, ASTM C1048; and ASTM C1036 Type I, Class 1, Quality Q2, with silvering as required.
- F. Adhesive: Two component epoxy type, waterproof.
- G. Fasteners, Screws, and Bolts: Stainless steel except where fully concealed may be hot dip galvanized; tamper-proof; security type.
- H. Expansion Shields: Fiber, lead, or rubber as recommended by accessory manufacturer for component and substrate.

2.04 FINISHES

- A. Stainless Steel: Satin finish, unless otherwise noted.
- B. Chrome/Nickel Plating: ASTM B456, SC 2, polished finish, unless otherwise noted.

2.05 COMMERCIAL TOILET ACCESSORIES

- A. Combination Toilet Paper/Seat Cover Dispenser with Napkin Disposal: Double roll; Recessed flush with wall, stainless steel; seamless wall flanges, continuous piano hinges.
1. Minimum capacity: 500 seat covers.
 2. Waste receptacle capacity: 0.8 gallons.
 3. TTD-1/2 Basis of Design Product: Recessed Toilet Tissue / Seat Cover Dispenser / Waste Disposal, B-3574 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- B. Combination Towel Dispenser/Waste Receptacle: Recessed with projecting waste receptacle, stainless steel; seamless wall flanges, continuous piano hinges.

1. Waste receptacle liner: Reusable, heavy-duty vinyl.
 2. Towel dispenser capacity: 600 C-fold.
 3. Waste receptacle capacity: 12 gallons.
 4. WRC-1 Basis of Design Product: Classic Series Recessed Convertible Paper Towel Dispenser and Waste Receptacle B-3944 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- C. Automated Soap Dispenser: Liquid soap dispenser, wall-mounted, with stainless steel cover and window to gauge soap level, tumbler lock.
1. Minimum Capacity: 30 ounces.
 2. SD-1 Basis of Design Product: Surface-Mounted Automatic Liquid Soap Dispenser, Satin Finish, B-2012 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- D. Mirrors: Stainless steel framed, 1/4 inch thick annealed float glass; ASTM C1036.
1. Annealed Float Glass: Silvering, protective and physical characteristics in compliance with ASTM C1503.
 2. Size: As indicated on drawings.
 3. Frame: 0.05 inch angle shapes, with mitered and welded and ground corners, and tamperproof hanging system; satin finish.
 4. Backing: Full-mirror sized, minimum 0.03 inch galvanized steel sheet and nonabsorptive filler material.
 5. MR-1 Basis of Design Product: Mirror with Stainless Steel Channel Frame B-165.2430 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- E. Seat Cover Dispenser: Stainless steel, surface-mounted, reloading by concealed opening at base, tumbler lock.
1. Minimum capacity: 250 seat covers.
 2. Product: See schedule on Drawings.
 3. TSD-1 Basis of Design Product: Classic Series Surface Mounted Seat Cover Dispenser B-221 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- F. Grab Bars: Stainless steel, peened surface.
1. Standard Duty Grab Bars:
 - a. Push/Pull Point Load: 250 pound-force, minimum.
 - b. Dimensions: 1-1/4 inch outside diameter, minimum 0.05 inch wall thickness, concealed flange mounting, 1-1/2 inch clearance between wall and inside of grab bar.
 - c. Finish: Satin, with peened gripping surface (suffix.99).
 - d. Length and Configuration: As indicated on drawings. Comply with CBC Ch. 11B-604.5.
 - 1) Minimum Length for Side Wall of Water Closet: 48 inches.
 - (a) At prefabricated partition, provide mid-span support of less than 36 inches with a ASTM A666, Type-304, 16 gauge, 0.0625 inch stainless steel with satin-finish back up plate and through-bolts at each mounting location.
CBC Ch. 11B-604.5.1 and DSA IR 16-12
 - 2) Minimum Length for Rear Wall of Water Closet: 42 inches.

- e. GB-1 & GB-2 Basis of Design Product: Snap Flange B-5806 Series as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- G. Clothes Hook and Bumper: Satin stainless steel clothes hook.
 - 1. Mounting: Concealed wall plate.
 - 2. Basis of Design Product: B-2116 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- H. Sanitary Napkin Disposal Unit: Stainless steel, surface-mounted, self-closing door, locking bottom panel with full-length stainless steel piano-type hinge, removable receptacle.
 - 1. Product: See schedule on Drawings.
 - 2. Basis of Design Product: Recessed Sanitary Napkin Disposal B-353 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.

2.06 UNDER-LAVATORY PIPE AND SUPPLY COVERS

- A. Specified in 22 40 00 - Plumbing Fixtures.

2.07 ELECTRIC HAND/HAIR DRYERS

- A. Electric Hand and Hair Dryers: Traditional fan-in-case type, with downward fixed nozzle.
 - 1. Operation: Automatic, sensor-operated on and off.
 - 2. Mounting: Wall-mounted - surface.
 - 3. Cover: Plastic.
 - a. Color: White.
 - b. Tamper-resistant screw attachment of cover to mounting plate.
 - c. Screen or shield to prevent access to motor/heater.
 - 4. Supply Voltage: As indicated on drawings.
 - 5. Warranty: 3 years.
 - 6. HD-1 District Standard Basis of Design Product: Air Blade V Hand Dryer as manufactured by Dyson, or approved equal.
 - 7. Retrofit Receptor: To fit existing waste receptacle/towel dispenser.
 - a. Products:

2.08 UTILITY ROOM ACCESSORIES

- A. Utility Shelf:
 - 1. Description: With exposed edges turned down not less than 1/2 inch (13 mm) and supported by two triangular brackets welded to shelf underside.
 - 2. Size: 36 inches (914 mm) long by 8 inches (203 mm) deep.
 - 3. Material and Finish: Not less than nominal 0.05-inch- (1.3-mm-) thick stainless steel, No. 4 finish (satin).
 - 4. Product: See schedule on Drawings.
 - 5. Basis of Design Product: B-296 as manufactured by Bobrick Washroom Equipment, Inc., or approved equal.
- B. Combination Utility Shelf/Mop and Broom Holder: 0.05 inch thick stainless steel, Type 304, with 1/2 inch returned edges, 0.06 inch steel wall brackets.

1. Drying rod: Stainless steel, 1/4 inch diameter.
2. Hooks: Two, 0.06 inch stainless steel rag hooks at shelf front.
3. Mop/broom holders: Three spring-loaded rubber cam holders at shelf front.
4. Length: 36 inches.
5. Product: See schedule on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify exact location of accessories for installation.
- C. Before covering wall framing with gypsum board, examine framing to ensure that backing plates and grab bar mounting kits have been installed behind surface mounted accessories in such positions as to receive all attachment screws.
- D. Verify that pipes, vents, conduits and other construction features do not protrude into rough wall opening space required for recessed accessories.
- E. For electrically-operated accessories, verify that electrical power connections are ready and in the correct locations.
- F. Verify that field measurements are as indicated on drawings.
- G. Verify installation of blocking, reinforcing plates, and concealed anchors in walls and ceilings.

3.02 PREPARATION

- A. Deliver inserts and rough-in frames to site for timely installation.
- B. Provide templates and rough-in measurements as required.

3.03 INSTALLATION

- A. Install accessories in accordance with manufacturers' instructions in locations indicated on drawings.
 1. Exception: Install surface mounted accessories other than grab bars with screws, molly or toggle bolts only to studs or through backing plates attached directly to studs.
 2. At combination units placed behind a grab bar set the perimeter trim tight against the backing board.
 - a. Face of this unit shall not project beyond the tile or applied finish face. Maintain the required 1-1/2 inch clearance.
 - b. Coordinate surrounding finish trim with bullnose tile, radius, or sloped profile trim.
- B. Install plumb and level, securely and rigidly anchored to substrate.
- C. Mounting Heights: As required by accessibility regulations, unless otherwise indicated.
 1. Grab Bars: As indicated on drawings.
 - a. Adult mounting height to be between minimum 33 inches to maximum 36 inches to top tangent point. CBC 11B-609.4 Position of Grab Bars.
 2. Mirrors: 40 inch, measured from floor to bottom of mirrored surface.
 3. Seat Cover Dispenser:

- a. Shall not be located closer than 1-1/2 inches clear of the tangent point of the grab bar.
 - b. If surface mounted and located under the grab bar provide a minimum 5 inches clear under unit for refilling.
4. Clothes Bumper/Coat Hook: 40 to 48 inches. CBC 11B-603.4 Coat hooks, shelves and medicine cabinets
5. Shelf with Mop and Broom Holders: 40 to 48 inches. CBC 11B-603.4 Coat hooks, shelves and medicine cabinets
6. Other Accessories: As indicated on drawings.

3.04 PROTECTION

- A. Protect installed accessories from damage due to subsequent construction operations.

END OF SECTION

SECTION 10 44 00 FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire blankets.
 - 1. At rooms with open flame.
- C. Fire extinguisher cabinets.
- D. Emergency Access Key Boxes
- E. Accessories.

1.02 RELATED REQUIREMENTS

- A. Section 09 21 16 - Gypsum Board Assemblies: Finishing at recessed fire extinguisher cabinets.

1.03 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2023a.
- B. FM (AG) - FM Approval Guide; Current Edition.
- C. Fire Extinguishers Standard: California Fire Code (CFC) section 906.
- D. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- E. ANSI/UL 711 - Rating and Fire Testing of Fire Extinguishers; 2018.
- F. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2022.
- G. CAL Title 19 Chapter 3 - California Code of Regulations (CCR), Title 19, Division 1, Chapter 3, Fire Extinguishers; Current Edition.
- H. CBC - California Building Code; Current Adopted Edition.
- I. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- J. NFPA 10 - Standard for Portable Fire Extinguishers; 2022.
- K. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth; 2024.
- L. UL (DIR) - Online Certifications Directory; Current Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide extinguisher operational features, extinguisher ratings and classifications, color and finish, anchorage details, and installation instructions.
- C. Shop Drawings: Indicate locations of cabinets and cabinet physical dimensions.
- D. Manufacturer's Installation Instructions: Indicate special criteria and wall opening coordination requirements.
 - 1. Submit for fire extinguishers and cabinets, and indicate compliance with local and State fire regulations for extinguisher mounting heights and locations.
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.

- F. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.05 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Conform to all requirements of the local and State Fire Marshal. Conform to all applicable requirements of the California Building Code (CBC), CFC, ADA Standards, and Title 19 CCR.
1. Fire Extinguisher cabinets must comply with CBC Ch. 11B-305 Clear floor or ground space, 11B-307 Protruding Objects, CBC Ch. 11B-308 Reach Ranges, CBC Ch. 11B-309/811.4 Operable Parts, CBC Ch. 11B-403 Walking Surfaces, CBC Ch. 11B-811.3 Height.
 2. Comply with CBC Ch. 11B-205 Operable Parts and 309 Operable Parts; Controls and operating mechanisms shall be operable with one hand and shall not require tight grasping, pinching or twisting of the wrist. The force required to activate controls shall be no greater than 5 lbf (22.2 N) of force. CBC Ch. 11B-309.4 Operation.
- B. Fire Extinguisher Requirements: Conform to NFPA 10, California Fire Code and Title 19 requirements for portable fire extinguishers.
- C. Current listing by California State Fire Marshal.

2.02 MANUFACTURERS

- A. Fire Extinguishers:
1. Activar Construction Products Group, Inc. - JL Industries; Cosmic Extinguisher - Multipurpose Chemical: www.activarcpg.com/#sle.
 2. Amerex; www.amerex-fire.com.
 3. Ansul, Inc. Sentry: www.ansul.com.
 4. Kidde, a unit of United Technologies Corp: www.kidde.com.
 5. Larsen's Manufacturing Co; Model No. MP5: www.larsensmfg.com.
 6. Nystrom, Inc: www.nystrom.com/sle.
 7. Potter-Roemer; Model 3005: www.potterroemer.com/#sle.
 8. Pyro-Chem, a Tyco Business: www.pyrochem.com/#sle.
 9. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Fire Extinguisher Cabinets and Accessories:
1. Activar Construction Products Group, Inc. - JL Industries; Cosmopolitan Series: www.activarcpg.com/#sle.
 2. Kidde, a unit of United Technologies Corp: www.kidde.com.
 3. Larsen's Manufacturing Co: www.larsensmfg.com.
 4. Nystrom, Inc: www.nystrom.com.
 5. Potter-Roemer: www.potterroemer.com/#sle.
 6. Strike First Corporation of America: www.strikefirstusa.com.
 7. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10, CAL Title 19 Chapter 3, and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL (DIR) or FM (AG) for purpose specified and as indicated.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage. Fully serviced and tagged.
 - 1. Stored Pressure Operated: Deep Drawn.
 - 2. Class: 2-A: 20B:C.
 - 3. Size: 10 pound.
 - 4. Size and classification as scheduled.
 - 5. Finish: Baked polyester powder coat color as selected.

2.04 FIRE EXTINGUISHER CABINETS

- A. Fire Rating: Listed and labeled in accordance with ASTM E814 and ASTM E119 requirements for fire resistance rating of walls where being installed.
- B. Cabinet Construction: Non-fire rated.
 - 1. Formed stainless steel sheet; 0.036 inch thick base metal.
 - 2. Basis of Design Product; 6 inch stud: Cosmopolitan Stainless Steel FE Cabinet Recessed 1035V17LDVRFE Flat Trim as manufactured by Activar, or approved equal.
 - 3. Basis of Design Product; 4 inch stud: Cosmopolitan Stainless Steel FE Cabinet Semi-Recessed 1036V17LDVRFE 1-1/2" Square Trim as manufactured by Activar, or approved equal.
 - 4. Basis of Design Product; Surface Mounted: Cosmopolitan Stainless Steel FE Cabinet Surface Mounted 1033V17LDVRFE as manufactured by Activar, or approved equal.
- C. Fire Rated Cabinet Construction: One-hour fire rated, or as required by wall assembly.
 - 1. Steel; double wall or outer and inner boxes with 5/8 inch thick fire barrier material.
 - 2. Basis of Design Product; 6 inch stud: Cosmopolitan Stainless Steel FX2 Fire Rated FE Cabinet Semi-Recessed 1036V17FX2-LDVRFE 1-1/2" Square Trim as manufactured by Activar, or approved equal.
- D. Cabinet Configuration: Semi-recessed type.
 - 1. Size to accommodate accessories.
 - 2. Exterior nominal dimensions of 13-7/8 inch wide by 27-3/8 inch high by 6 inch deep.
 - 3. Trim: Flat rolled edge, with 13-7/8 inch wide face.
 - 4. Projected Trim: Returned to wall surface, with 3 inch projection, and 1.69 inch wide face.
 - 5. Provide cabinet enclosure with right angle inside corners and seams, and with formed perimeter trim and door stiles.
- E. Door: 0.036 inch metal thickness, reinforced for flatness and rigidity with roller type catch. Hinge doors for 180 degree opening with continuous piano hinge.
 - 1. Provide manufacturer's option for compliance with Americans with Disabilities Act (ADA) projection criteria and accessible handle.

2. Latching and locking hardware operable with a single effort by lever-type hardware or other type hardware not requiring ability to grasp opening hardware and not requiring an opening force greater than 5 pounds.
- F. Door Style: Slot glazed style vertical duo-panel with glazing, continuous hinge, roller catch, zinc plated pull handle and cylinder lock.
 1. Door Glazing: Acrylic plastic, clear, 1/8 inch thick, flat shape and set in resilient channel glazing gasket.
- G. Cabinet Mounting Hardware: Appropriate to cabinet, with pre-drilled holes for placement of anchors.
- H. Fabrication: Weld, fill, and grind components smooth.
- I. Finish of Cabinet Exterior Trim and Door: No.4 - Brushed stainless steel.
- J. Finish of Cabinet Interior: White colored enamel.

2.05 EMERGENCY ACCESS KEY BOXES

- A. Fire Department Lock Box: Heavy-duty, mounting according to application, solid stainless-steel box with hinged door and interior gasket seal; single drill resistant lock with dust covers and tamper alarm.
 1. Capacity: Holds 10 keys.
 2. Finish: Manufacturer's standard finish as selected by Architect.
 3. Products:
 - a. Knox Company; Knox-Box Rapid Entry System: www.knoxbox.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 4. Recessed at Buildings or Site Walls:
 - a. Lock boxes shall be mounted to the left or right of the main entrance door/gate and as indicated on the Drawings.
 - b. Knox box at buildings shall be mounted 6 feet from top of box to finished grade, or at a location and height approved by the Fire Department.
 - c. Products:
 - 1) Knox Company; Model 3227.
 - 2) Substitutions: See Section 01 60 00 - Product Requirements. Only if allowed or required by local Fire Department.
 5. The Knox Fire Department alert decals shall be provided on all exterior doors of the facility and on all interior doors that keys have been furnished for within the lock box.
 - a. If the building/facility is protected with a fire alarm system or burglar alarm system, the lock boxes shall be "tamper" monitoring.
 - b. The tamper monitoring must include the following:
 - 1) All central stations shall be UL listed.
 - 2) For combination Fire/Burglar Alarm Panels, the Knox Box monitoring shall be through the fire side of the panel.
 - (a) For buildings with only burglar alarm systems, the Knox Box tamper monitoring shall be on a separate 24 hour, instant, non-shuntable burglar alarm zone.
 - 3) Central stations upon receiving a Knox Box tamper alarm signal shall:
 - (a) Notify and respond to local Police Department (Knox Box tamper).

(b) Notify and respond to the local Fire Department (Knox Box tamper).

B. Manufacturer: Knox Company, Irvine, California, to match existing system.

2.06 ACCESSORIES

A. Fire Blanket: Fire retardant treated wool; red, 62 by 84 inch size.

1. Provide at locations where an open flame may occur, such as science rooms, CTE programs, and kitchens. (Per Education Code)

B. Extinguisher Brackets: Formed steel, chrome-plated.

1. Where indicated, at Custodial, Mechanical and Electric Rooms, provide surface mounted bracket with retainer straps.
2. Provide brackets with 3-point connection within cabinets and for locations where fire extinguisher is wall-mounted without cabinet.
 - a. Bracket design shall prevent accidental dislodgement of extinguisher.
 - b. Provide size required for type and capacity of specified extinguisher.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.02 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install cabinets in prepared recesses in walls. Verify recess dimensions for standard non-rated and fire rated where required.
- C. Install cabinets plumb and level in wall openings, 24 inches from finished floor to inside bottom of cabinet.
 1. Cabinet installation shall conform to requirements of the Fire Marshal, CBC, and ADA for location and height of extinguisher.
 2. Place cabinet to position the extinguisher handle at maximum 48 inches AFF.
 3. Place Cabinet maximum 40 inches (1,016 mm) AFF to centerline of cabinet handle.
- D. Secure rigidly in place.
 1. Use oval head fasteners with exposed surfaces of same finish as cabinet.
 2. Fasten cabinets to metal studs or framing with sheet metal screws
 3. Fasten cabinets to wood studs with full threaded wood screws or with sheet metal screws.
- E. Maintain acoustical integrity of walls by filling cavity around box with unfaced fiberglass insulation or by applying electrical outlet box acoustical sheeting to the back, top, bottom and sides.
- F. Place extinguishers in cabinets and on wall brackets.
 1. Mount freestanding fire extinguishers on steel brackets on walls at locations indicated on drawings, with fire extinguisher handle located maximum 48-inches above finish floor. Mount steel brackets to solid backing.
 2. Mount fire extinguishers to brackets in all cabinets.

3. Place fire extinguishers immediately prior to issuance of "Notice of Completion" or sooner if directed by Fire Marshal or District.

3.03 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

3.04 SCHEDULES










- A. Provide extinguishers and cabinets in quantities and locations as indicated per Drawings, or as indicated by field inspection by Fire Marshall.
- B. Conform to CBC Section 906.
- C. Place the fire extinguishers based on the allowable maximum travel distance to extinguisher as indicated on Drawing and as follows:

1. Class A = 75 feet
2. Class B = CBC Table 906.3(2)

Hazard Type	Min. Extinguisher Rating	Max. Travel Distance
Light (Low)	5-B	30 Feet
	10-B	50 Feet
Ordinary (Moderate)	10-B	30 Feet
	20-B	50 Feet
Extra (High)	40-B	30 Feet
	80-B	50 Feet

3. Class C = 50 Feet
4. Class K = 30 Feet
 - a. Comply with CFC 906.4 for spacing and quantity.
 - 1) Maximum 30 feet from cooking device ("hazard").
- D. General Use: 1 Dry Chemical Type 2A-20BC, 10 lb. capacity, baked enamel finish extinguisher; Cabinet recessed mounting.
- E. Multi-Purpose Room: 1 Dry Chemical Type 4A-80BC, 10 lb. capacity, baked enamel finish extinguisher placed in specified cabinet.
- F. Electrical Equipment Room: 1 Dry Chemical Type 4A:40B:C, 10 lb. capacity; Wall bracket surface mounting.

3.05 TYPES

Fire Class	Geometric Symbol	Pictogram	Intended Use	Mnemonic
A			Ordinary solid combustibles	A for "Ash"
B			Flammable liquids and gases	B for "Barrel"
C			Energized electrical equipment	C for "Current"
D		(none)	Combustible metals	D for "Dynamite"
K			Oils and fats	K for "Kitchen"

Fire extinguishing capacity is rated in accordance with ANSI/UL 711: Rating and Fire Testing of Fire Extinguishers.

The ratings are described using numbers preceding the class letter, such as 1-A:10-B:C.

The number preceding the A multiplied by 1.25 gives the equivalent extinguishing capability in gallons of water.

The number preceding the B indicates the size of fire in square feet that an ordinary user should be able to extinguish.

There is no additional rating for class C, as it only indicates that the extinguishing agent will not conduct electricity, and an extinguisher will never have a rating of just C.

END OF SECTION

SECTION 10 75 00 FLAGPOLES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aluminum Flagpoles.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Concrete base and foundation construction.
- B. Section 01 10 00 - Summary: District furnished products; flags.
- C. Section 31 23 16 - Excavation: Foundation earthwork.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines; current edition.
- B. AASHTO M 36 - Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains; 2016 (Reapproved 2020).
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- D. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- E. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2021.
- F. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric); 2021.
- G. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- H. NAAMM FP 1001 - Guide Specifications for Design Loads of Metal Flagpoles; 2007.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pole, accessories, and configurations for each type of flagpole required. Include data for fittings and accessories.
- C. Shop Drawings: Indicate detailed dimensions, base details, anchor requirements, and imposed loads.
- D. Calculations: Submit engineering calculations and design for flagpole foundation assembly and pole per loads of CBC Chapter 16A.
 - 1. Design criteria as appropriate to the locale of the Project: NAAMM FP 1001 .
 - 2. Furnish calculations and drawings in a form acceptable to Architect.
 - 3. Calculations and foundation design shall be prepared and signed by a civil or structural engineer currently registered to practice in the State of California.
- E. Certificate: Submit professional structural engineer's certification that design complies with requirements of the contract documents.
- F. Manufacturer's Instructions: Submit for each product specified in this section. Include instructions for examination, preparation, and protection of adjacent work.

- G. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules and cleaning.

1.05 QUALITY ASSURANCE

- A. Manufacturer's Qualifications: Firm regularly engaged in manufacture of products specified in this section, and whose products have been in satisfactory use under similar service conditions for not less than 5 years.
- B. Installer's Qualifications: Firm regularly engaged, for the preceding five years, in the installation of flagpoles of equivalent type and physical characteristics to those required. If requested by Architect submit verifiable list of not less than five projects of equivalent type successfully completed within the preceding two years.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Spiral wrap flagpole with protective covering and pack in protective shipping tubes or containers.
- B. Protect flagpole and accessories from damage or moisture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Flagpoles:
 - 1. Baartol Company, Inc., a division of Eder Flag Mfg. Co. Inc.; Architectural Series, Model EC("height"): www.ederflag.com
 - 2. Concord Industries, Inc: www.concordindustries.com.
 - 3. Flagpole Warehouse Division of The Flag Company, Inc.: www.flagpolewarehouse.com.
 - 4. Morgan Francis Flagpoles & Accessories: www.morgan-francis.com.
 - 5. Pole-Tech Co., Inc: www.poletech.com.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FLAGPOLES

- A. Flagpoles: Designed in accordance with NAAMM FP 1001
 - 1. Material: Aluminum.
 - 2. Design: Cone tapered.
 - 3. Mounting: Ground mounted type.
 - 4. Outside Butt Diameter: 6 inches.
 - 5. Outside Tip Diameter: 3.5 inches.
 - 6. Nominal Wall Thickness: 0.188 inches.
 - 7. Nominal Height: 35 ft; measured from nominal ground elevation.
 - 8. Halyard: Internal type, electric operation.
- B. Performance Requirements:
 - 1. Wind Pressure Loading on Flagpole with Flag: Resistant without permanent deformation to 110 miles/hr wind speed, in accordance with NAAMM FP 1001; the factor of safety used is 2.5.

- C. Pole Construction: Construct pole and ship to site in one piece if possible. If more than one piece is necessary, provide snug- fitting, precision joints with self-aligning, internal splicing sleeve arrangement for weather-tight hairline field joints.

2.03 POLE MATERIALS

- A. Aluminum: ASTM B221 (ASTM B 221M) , 6063 alloy , T6 temper.

2.04 ACCESSORIES

- A. Finial Ball: Aluminum, 6 inch diameter, Gold anodized.
- B. Truck Assembly: Cast aluminum; revolving, stainless steel ball bearings, non-fouling.
- C. Winged Cleats: 9 inch size, aluminum with stainless steel fastenings, one per halyard.
 - 1. Locate top of cleats maximum 47 inches above finish walking surface.
 - 2. Comply with CBC 11B-308, ADA Standards, and 36 CFR 1191.
 - a. DSA Note: A typical winged cleat, completely within 48 inches of the finish surface, is interpreted to meet the accessibility requirement of CBC Ch. 11B-309.4.
- D. Halyard: 5/16 inch diameter nylon, braided, white.
 - 1. Provide 2 continuous halyards for each flagpole
 - 2. Halyard Flag Snaps: Provide 2 swivel snaps per halyard, chromium-plated bronze.
- E. Connecting Sleeve For Multiple Section Poles: Same material as pole, precision fit for field assembly of pole, concealed fasteners.
- F. Primer: Zinc chromate type.

2.05 MOUNTING COMPONENTS

- A. Foundation Tube Sleeve: AASHTO M 36, corrugated 16 gage, 0.0598 inch steel, galvanized, depth of 38-1/2 inches as indicated.
 - 1. Steel centering wedges: Minimum 1/8 inch thick wedges, welded to sleeve plate inside foundation sleeve for the purpose of centering pole.
- B. Pole Base Attachment: Flush; steel base with base cover.
 - 1. Foundation support plate: Square steel plate welded to electrical grounding spike at base of concrete foundation.
 - a. Minimum edge dimension of square plate: 6-inches.
 - b. Minimum thickness: 3/16 inch.
 - 2. Provide manufacturer's standard flash collar, finished to match flagpole.
- C. Lightning Ground Cable: Copper No. 6 AWG, soft drawn.

2.06 FINISHING

- A. Metal Surfaces in Contact With Concrete: Asphaltic paint.
- B. Concealed Steel Surfaces: Galvanized to ASTM A123/A123M requirements.
- C. Aluminum: Mill finish.
- D. Finial: Gold anodized finish.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that concrete foundation is ready to receive work and dimensions are as indicated on shop drawings.
- B. Verify an adjacent 30 x 48 inch clear firm, stable and level surface area for cleat access. CBC Ch. 11B and ADA Standards.

3.02 PREPARATION

- A. Coat metal sleeve surfaces below grade and surfaces in contact with dissimilar materials with asphaltic paint.

3.03 REGULATORY REQUIREMENTS

- A. When flagpoles are provided for the raising and lowering of the flag, accessible operation is required. Flagpoles with accessible hardware, on an accessible route, within accessible reach from a firm stable and level, minimum 30"x48" clear floor space shall be provided. Note that a typical winged cleat, completely within 48" of the finish grade, is interpreted to meet the accessibility requirement of CBC Section 11B-309.4.

3.04 INSTALLATION

- A. Install flagpole , base assembly, and fittings in accordance with manufacturer's instructions.
- B. Electrically ground flagpole installation.
- C. Install foundation plate and centering wedges for flagpoles base set in concrete base and fasten.

3.05 TOLERANCES

- A. Maximum Variation From Plumb: 1 inch.

3.06 ADJUSTING

- A. Adjust operating devices so that halyard and flag function smoothly.

END OF SECTION

SECTION 10 82 33 TREILLAGE

PART 1 - GENERAL

1.01 SUMMARY

- A. Section includes: Trellis panels with accessories.

1.02 RELATED SECTIONS:

- A. Section 04 22 00 - Concrete Unit Masonry.
- B. Section 06 10 00 - Rough Carpentry: Blocking and supports.
- C. Section 32 93 00 - Planting.

1.03 REFERENCES:

- A. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- B. ASTM A641/A641M - Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire; 2019.
- C. ASTM A879/A879M - Standard Specification for Steel Sheet, Zinc Coated by the Electrolytic Process for Applications Requiring Designation of the Coating Mass on Each Surface; 2022.
- D. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.

1.04 SUBMITTALS

- A. Submit in accordance with Section 01 30 00 - Administrative Requirements.
- B. Product Data: Submit manufacturer's product data, standard details, and installation instructions.
- C. Shop Drawings: Submit showing sizes critical dimensions, panel layout constraints using a modular grid, and details and locations of accessories.
- D. Color samples are not ordinarily required. However, text below may be retained below if required to verify appearance of custom colors.
- E. Color Submittals: Submit coupons 2 x 3-1/2 inches minimum showing color and texture to be provided.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Protect materials from damage. Store panels flat. Provide edge protection when strapping is used. Do not apply loads to panel edges.
- B. In addition to the sustainability factors below, GREENscreen® can reduce energy requirements for cooling; use a deciduous vine to shade your building against summer sun but allow it to be warmed by winter sun.

1.06 ENVIRONMENTAL REQUIREMENTS

- A. Contact manufacturer before specifying recycled content to verify current raw material availability.

PART 2 - PRODUCTS

2.01 MANUFACTURER

- A. Basis of Design : As manufactured by GREENscreen®, Los Angeles, CA; phone 800-450-3494, fax 310-837-0523, www.greenscreen.com, or equal.

2.02 PANELS

- A. Panels: Rigid, three-dimensional welded wire grid fabricated of 14-gage ASTM A641/A641M galvanized steel wire.
- B. Face Grid: Wires welded at each intersection to form a 2 x 2 inch face grid on the front and back of panels,
- C. Trusses: Face grids separated by bent wire trusses spaced at 2 inch centers and welded to front and back face grids at each truss apex.
- D. 3 inch thick panels can be used at wall-mounted conditions, edge-mounted conditions with supports at up to 96 inches on center, and at horizontal or inclined (overhead) conditions with supports at up to 48 inches on center.
- E. Thickness: As shown on Drawings
- F. Length and Width: Provide in 2 inch nominal increments.
- G. Tolerance: 1/8 inch in width and 1/4 inch in length.

2.03 ACCESSORIES

- A. Trim is recommended adjacent to pedestrian traffic areas and where required visually or to provide an edge to which vines can be trimmed for maintenance. Do not use channel trim at bottom of panels where it could hold water and restrict plant growth.
- B. Trim:
 - 1. Fabricate from 20-gage ASTM A879/A879M galvanized steel.
 - 2. Types:
 - a. Channel Trim: Thickness of panel x 1/2 inch legs.
 - b. Angle Trim: 1/2 inch x 1/2 inch legs.
 - 3. Locations: Where indicated on Drawings
 - a. Corners formed by intersections of panels: Angle type.
 - b. Top of Treillage (where Exposed to Pedestrians): Angle type.
 - c. Side of Treillage (where Exposed to Pedestrians): Angle type.
 - d. Bottom of Treillage (where Exposed to Pedestrians): Angle type.
 - e. If panel exterior face of panel is more than 18 inches in front of substrate, contact GREENscreen® for custom designed mounting brackets.
- C. Clips and Straps: Provide manufacturer's standard types of clips and straps suitable for mounting conditions. Fabricate from ASTM A879/A879M galvanized steel. Adjustable clips shall have 1/4 inch diameter 18-8 stainless steel bolt, washer, and nut.
- D. Spacers are recommended when panels are mounted directly to a wall.
- E. Plastic Spacers: Provide 1/2 inch thick black Ultra High Molecular Weight polyethylene (UHMW) washers [to hold clips away from mounting surface].

- F. Post imbed length and footing size should be determined based on overall height, spacing, wind load, soil conditions, and type of footing. Detail footing on drawings.
- G. Fence Posts: 3 inch diameter ASTM A500/A500M steel tube. Provide steel post caps.
- H. Fasteners for Mounting Clips to Fence Posts: Self drilling, self tapping hex washer head screws, Type 410 stainless steel, and free from rust when salt spray tested for 300 hours in accordance with ASTM B117.
- I. Fasteners for Attachment to Structure:
 - 1. Wood Framing: 550 lbs. minimum pull-out resistance
 - 2. Provide blocking between studs where GREENscreen® is to be mounted to light gage steel framing or wood framing.

2.04 FABRICATION

- A. Cut to size.
- B. Weld trim to panels and grind smooth exterior surfaces of welds.

2.05 FINISHES

- A. Metal components (except fasteners) shall be factory finished after fabrication.
- B. Finish System: pretreat with general purpose, alkaline, water based cleaner / degreaser applied at 240 degrees F. prime with zinc-rich epoxy powder coat. Topcoat with polyester or polyester-urethane powder coat.
- C. Salt Spray Resistance: Finish shall remain rust free when tested 1680 hours in accordance with ASTM B117.
- D. Color: Color selected by Architect from manufacturer's standards
- E. Touch-Up Paint: Provide high quality, exterior-grade spray paint suitable for conditions of use.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Inspect substrates and conditions affecting work of Section. Do not proceed until unsatisfactory conditions have been corrected.

3.02 PREPARATION

- A. Fence Posts: Install posts as shown on Drawing.

3.03 INSTALLATION

- A. Install panels plumb and square, centered within area designated for panels, and aligned to maintain modular grid.
- B. Avoid cutting panels in field. Where field cutting is essential, apply touch-up paint to cut edges.
- C. Install securely with fasteners located to meet manufacturer's requirements
- D. Repair bent or damaged panels. If panels cannot be repaired to satisfaction of Architect, remove from jobsite and replace with new panels.

END OF SECTION

SECTION 11 12 00 PARKING CONTROL EQUIPMENT

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Parking access controls.
 - 1. Gate arm access control.
- B. Maintenance.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Placement of anchors and components to be embedded in concrete.
- B. Section 26 05 83 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
- B. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- D. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- E. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- F. IEC 60950-1 - Information Technology Equipment – Safety - Part 1: General Requirements.
- G. ITS (DIR) - Directory of Listed Products.
- H. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- I. NEMA MG 1 - Motors and Generators.
- J. NFPA 70 - National Electrical Code.
- K. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- L. UL (DIR) - Online Certifications Directory.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on operating equipment, characteristics, limitations, and temperature range of operation.
- C. Shop Drawings: Indicate plan layout of equipment access lanes, curbing, mounting bolt dimensions, conduit and outlet locations, power requirements, and wiring diagrams.
- D. Samples: Submit two samples of access cards illustrating size and coding method.
- E. Samples: Submit two samples 6 inches long of preformed steel curb frame.

- F. Manufacturer's Qualification Statement.
- G. Installer's Qualification Statement.
- H. Maintenance Contract.
- I. Operation Data: Submit data for operating equipment, clock timer, and changing security access code.
- J. Maintenance Data: Provide lubrication and periodic maintenance requirement schedules.
- K. Warranty Documentation: Submit manufacturer warranty and ensure forms have been completed in District's name and registered with manufacturer.
- L. Record Documentation: Record and submit actual locations of concealed conduit.
- M. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Spare Parts: Two extra gate arm assemblies.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for operating equipment.

PART 2 PRODUCTS

2.01 DESCRIPTION

- A. Parking Control System: Automatic operation at entrance and automatic operation at exit.
- B. Provide protection against interference or damage by lightning or other electrical influences; include fuse, over-voltage protection, flash-over protection, and line filter.
- C. Entry: Automatic parking access control system is activated upon detection of coded card.
 - 1. Universal Receiver for Commercial Applications: 850LM Radio Receiver.
- D. Exit: Automatic parking access control system is activated upon detection of vehicle by sensing loop in pavement.

2.02 REGULATORY REQUIREMENTS

- A. Comply with applicable code and requirements of authorities having jurisdiction for emergency vehicle access.
 - 1. Provide local fire department access by knox system, key card, or remote control, as approved by local fire district.
- B. Products Requiring Electrical Connection: Listed and classified by ITS (DIR), UL (DIR), or testing firm acceptable to authorities having jurisdiction as suitable for purpose specified.

2.03 PERFORMANCE CRITERIA

- A. Operating Temperature: Minus 20 to 140 degrees F.
- B. Humidity: 15 to 95 percent RH noncondensing.
- C. Agency Certifications: IEC 60950-1.
- D. Rating: IEC 60950-1 under NEMA 250.

2.04 PARKING ENTRY/EXIT COMPONENTS

- A. Gate Arm - Entry and Exit Control: Provide equipment listed and labeled in compliance with UL 325 safety standards of gate operators.
 - 1. Basis of Design Product: MAT, High-Traffic DC Barrier Gate Operator as manufactured by LiftMaster, www.liftmaster.com, or approved equal.
 - 2. Classification: Class II - Commercial/General Access, vehicular gate operator with gate arm access control complying with UL 325.
 - 3. Controls: Mechanism in compliance with UL 325 safety standards of gate operators, with zinc coated steel components to raise and lower arm by instant reversing electric motor, enclosed speed reducer operated by self contained, plug-in replaceable controller with slip clutch to prevent breakage if arm is forced, and to permit manual operation and arm movement to stop and start at reduced speed if required.
 - a. Activate automatic arm reversing switch if an obstacle is sensed when in downward motion.
 - b. Maintain gate arm in raised position until vehicle clears control area.
 - 4. Control Cabinet: Aluminum, with weather-tight seams and gaskets; thermally insulated to permit heater to maintain cabinet temperature to equipment operating minimum, flush access doors and panels, tamper proof hardware, master keyed locks, and concealed mounting bolts located inside of units.
 - 5. Gate Arm: Aluminum, 3 by 2-1/4 inch nominal, one piece, with internal counterbalance, rubber bottom safety edge, automatic arm reversing switch, and MALED12 Lamp Type: LED 2528 IP68 Silica Gel Filled; with 12 ft extension and break line in arm.
 - a. Color: Red/White
 - 6. Gate Arm Length: 12 feet.
 - 7. Gate Arm Height: Locate top of gate arm in down position at not more than 35 inches above pavement.
 - 8. Gate Arm Finish: Two coats of reflective enamel based paint with Red and White diagonal stripes on both sides of arm.
 - 9. Gate Arm Clamp: Cast metal, quick change clamp and hub bracket, to permit rapid replacement of gate arm without fitting or drilling.
 - 10. Pivot, Limit Stops, and Counterbalancing: Galvanized steel construction, enclosed in arm clamp, with oil impregnated bronze bearing.
 - 11. Gate Arm Support Post: Steel section; 37 inches high, 6 inches square, with 10 gauge, 0.135 inch minimum wall thickness; with welded and sealed steel post cap and base plate.
 - a. Finish: Baked enamel on steel, color as selected by Architect.
 - 12. Gate Arm End Post: Steel section; 37 inches high, 2 inch square, with 10 gauge, 0.135 inch minimum wall thickness; with alignment bracket, closed cap and base plate.

- a. Finish: Baked enamel on steel, color as selected by Architect.
- 13. Base Plate: Steel, welded to post, 6 inches larger than post, with anchor bolts into concrete slab.
- 14. Padlocking Feature: To lock gate arm in either open or closed position.

2.05 ELECTRICAL CHARACTERISTICS AND COMPONENTS

- A. Electrical Components: Self-contained, plug-in, and replaceable components that comply with NFPA 70 and are listed and labeled by UL (DIR) or ITS (DIR).
 - 1. Provide wiring for control units, zinc plated connection box, grounded convenience outlet, switch for automatic or manual operation, switch to disconnect power unit, thermostatically controlled with at least 250 watt heater strip, and thermally protected disconnect for motor.
- B. Motor: NEMA MG 1 compliant.
- C. Backup Power Inverter: Provides electrical power to allow system to remain in operation upon loss of primary electrical power.
- D. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box sized in compliance with NFPA 70.
- E. Disconnect Switch: Factory mount disconnect switch in control panel.

2.06 VEHICLE DETECTION

- A. Vehicle Detection: For use in temperature range of minus 40 to 160 degrees F; consisting of detection unit in conjunction with sensing loop to activate parking revenue control device or access control device when vehicle enters or exits.
- B. Sensing Loop: 14 gauge, 0.064 inch insulated wire; loop size of 48 by 72 inches, with loop extension cable and detector.
 - 1. Loop Groove Fill: Cold poured rubberized asphalt emulsion.
- C. Treadle Switch Plate: Galvanized steel, 12 by 72 inches overall size; consisting of weatherproof sensor detector.

2.07 MATERIALS

- A. Aluminum: Extruded aluminum in compliance with ASTM B221 or ASTM B221M.
- B. Steel: Hot-dipped galvanized steel sheet, ASTM A653/A653M, with G90/Z275 coating.
- C. Iron and Steel Hardware: Hot-dip zinc coating, ASTM A153/A153M.
- D. Structural Steel Tubing: ASTM A500/A500M

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that anchor bolts are ready to receive this work and dimensions are as required by manufacturer.
- B. Verify that electric connections are properly located and have necessary characteristics.

3.02 INSTALLATION

- A. Install parking control system and components in accordance with manufacturer's instructions and in compliance with requirements.
- B. Cut grooves in pavement surface, install vehicle detection loops and lead-in wires, and fill grooves with loop filler.
- C. Install internal electrical wiring, conduit, junction boxes, transformers, circuit breakers, and auxiliary components as required.

3.03 ADJUSTING

- A. Adjust system components for smooth operation.

3.04 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.
- C. Provide service and maintenance of operating equipment for a period of two years from Date of Substantial Completion.

END OF SECTION

SECTION 12 11 03 MURAL PAINTING AND FAUX FINISHES

PART 1 GENERAL

1.01 SUMMARY

- A. Specialty painting of mural by artisans.
- B. Mural to be painted on gypsum board or smooth trowel plaster on wall surfaces, where indicated on Drawings.
 - 1. Mural image to be provided by Architect or District.
- C. Painting of other building elements are specified in 09 91 13 - Exterior Painting, 09 91 23 - Interior Painting, 09 96 00 - High-Performance Coatings, and 09 96 23 - Graffiti-Resistant Coatings .
- D. Prepare and prime identified surfaces scheduled for paint.

1.02 RELATED REQUIREMENTS

- A. Section 01 61 16 - Volatile Organic Compound (VOC) Content Restrictions.
- B. Section 05 50 00 - Metal Fabrications: Shop-primed items.
- C. Section 09 91 13 - Exterior Painting.
- D. Section 09 91 23 - Interior Painting.

1.03 REFERENCE STANDARDS

- A. PDCA P1 - Touch Up Painting and Damage Repair: Financial Responsibility and Definition of a Properly Painted Surface; Current Edition.
- B. PDCA Standards - PDCA Industry Standards, Painting Contractors Association; 2019.
- C. SSPC-SP 2 - Hand Tool Cleaning; 2018.
- D. SSPC-SP 3 - Power Tool Cleaning; 2018.
- E. SSPC-SP 6 - Commercial Blast Cleaning; 2007.
- F. SSPC-SP 7 - Brush-Off Blast Cleaning; 2007.

1.04 DEFINITIONS

- A. System DFT: Dry film thickness of entire coating system unless otherwise noted.

1.05 SUBMITTALS

- A. General: Submit in accordance with Section 01 30 00 - Administrative Requirements.
- B. Product Data:
 - 1. Submit product data, including label analysis for each product proposed for use.
 - 2. Specifically include percent solids-by-volume, volatile organic compound (VOC) content in g/L, and lead content (percent of weight of dried film).
- C. Mural Shop Drawing: Scaled rendering with true representation of color and content placement.
- D. Color and Sheen Samples:

1. Prepare multiple samples of each opaque finish coating specified in each color and sheen scheduled for appearance verification.
 2. Apply to 1/4 inch hardboard. Apply sufficient coating thickness to provide proper hiding and appearance.
 3. Label each sample to indicate material, color, and sheen.
 4. Mural: 24 by 24 inches, two different scenes - all colors and sheen.
- E. Submit following Informational Submittals:
1. Certifications specified in Quality Assurance article.
 2. Qualification Data: Applicator's qualification data.
 3. Manufacturer's instructions.
- F. Closeout Submittals:
1. Submit under provisions of Section 01 70 00 - Execution and Closeout Requirements.
 2. Warranty: Submit specified warranty.

1.06 QUALITY ASSURANCE

- A. Comply with PDCA Standards.
- B. Single Source Responsibility:
1. Provide products of single manufacturer for use in each coating system.
 2. Do not mix products of different manufacturers without approval of Architect or Owner Representative and manufacturers involved.
 3. Provide manufacturer recommended materials (base and tints) for deep tone colors.
- C. Applicator Qualifications:
1. Company specializing in commercial painting and finishing with 3 years documented experience.
 2. Employ artisans with specialized training and abilities for Mural and plaster painting.

1.07 FIELD SAMPLES

- A. General: Comply with requirements of Section 01 40 00 - Quality Requirements.
- B. Sample Installation: Duplicate finishes of approved coating system samples on wall surfaces and other interior and exterior components selected by Agency.
- C. Provide full-coat finish on at least 10 sq. ft. of surface until required color, sheen, and texture are obtained. Simulate finished lighting conditions for review of in-place work.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in manufacturer's sealed and labeled containers; inspect to verify compliance with specified requirements.
- B. Label containers to indicate manufacturer's name, product name and type of coating, brand code or stock number, date of manufacture, coverage, surface preparation, drying time, cleanup, color designation and instructions for mixing and reducing.
- C. Store coating materials in tightly covered containers in well ventilated area at ambient temperatures of 45 degrees F minimum and 90 degrees F maximum, unless required otherwise by manufacturer. Maintain containers in clean condition, free of foreign materials and residue with labels in legible condition.
- D. Take precautionary measures to prevent fire hazards and spontaneous combustion.

1.09 PROJECT CONDITIONS

- A. Environmental Conditions: Comply with more restrictive of following or manufacturer's requirements under which systems can be applied.
 - 1. Do not apply coatings under any of following conditions:
 - a. When surfaces are damp or wet.
 - b. When relative humidity is less than 20 percent or exceeds 85 percent.
 - c. When temperature is less than 5 degrees F above dew point.
 - d. When dust may be generated before coatings have dried.
 - e. In direct sunlight.
 - f. When wind velocity is above 20 mph.

1.10 WARRANTY

- A. Comply with provisions of Section 01 78 00 - Closeout Submittals.
- B. Warrant installation to be free from defects in material and workmanship for 5 years.
- C. Repair or replace defects occurring during warranty period.
- D. Defects include but are not limited to pinholes, crazing or cracking, loss of adhesion to substrate, deficient thickness, improper materials and workmanship.

1.11 EXTRA STOCK MATERIAL

- A. Provide one unopened gallon container of each type of opaque top coating in each color and sheen used on Project.
- B. Store where directed with labels intact.

PART 2 PRODUCTS

2.01 SYSTEM REQUIREMENTS

- A. Interface with Adjacent Systems:
 - 1. Review other Sections specifying prime coats to ensure compatibility of total coating system for various substrates.
 - 2. Upon request from other trades, furnish information on characteristics of finish materials proposed for use to ensure compatibility of various coatings.
 - 3. Test compatibility of existing coatings, including shop applied primers and previously applied coatings, by applying specified special coating to small, inconspicuous area.
 - 4. If specified coating lifts or blisters existing coating, apply barrier or tie coat as recommended by coating manufacturer.
 - 5. If no compatible barrier or tie coat exists, remove existing coating completely and apply coating system as specified for new work.

2.02 COATING MATERIALS - GENERAL

- A. Coatings:
 - 1. Ready-mixed, factory tinted, best professional grade produced by manufacturer.
 - 2. Use manufacturer's appropriate base materials to achieve required colors.
 - 3. Fully grind pigments to maintain soft paste consistency in vehicle.

4. Capable of being dispersed into uniform, homogeneous mixture.
5. Possess good flowing and brushing properties.
6. Capable of drying or curing free of streaks or sags, and yielding specified finish.
7. VOC content of field applied coatings shall comply with local governing authorities.

2.03 FINISH COATINGS SCHEDULE

- A. See Section 09 91 13 - Exterior Painting and 09 91 23 - Interior Painting.

2.04 COLOR SCHEDULE

- A. Colors and sheen are indicated on Drawings.

2.05 PRIME COATINGS

- A. See Section 09 91 13 - Exterior Painting or 09 91 23 - Interior Painting.

2.06 ACCESSORY MATERIALS

- A. Muriatic acid, mildewcide, TSP (tri-sodium phosphate), acidic-detergent, zinc sulfate, sodium metasilicate, and solvent: Commercially available, non-damaging to surface being cleaned; as specified in PDCA P1; acceptable to coating manufacturer.
- B. Metal Conditioner: Proprietary phosphoric acid based, etching type solution; acceptable to coating manufacturer.
- C. Rust Inhibitor: Water containing 0.32 percent of sodium nitrite and 1.28 percent by weight of secondary ammonium phosphate (dibasic); or water containing 0.2 percent by weight of chromic acid or sodium chromate or sodium dichromate or potassium dichromate.
- D. Spackling compound, putty, plastic wood filler, liquid de-glosser, latex patching plaster, latex base filler, thinners, and other materials not specifically indicated but required to achieve finishes specified: Pure, of highest commercial quality, compatible with coatings and acceptable to coating manufacturer.
- E. Do not use products of different manufacturers in combination.

2.07 MIXING

- A. Use factory prepared colors matching approved samples. Site tinting will not be permitted.
- B. Thoroughly mix and stir coatings before use to ensure homogeneous dispersion of ingredients. Prior to application, blend multiple containers of same material and color by pouring from one container to another several times to ensure uniform consistency, color, and smoothness.
- C. Mix only in clean mixing pails of material recommended by manufacturer to avoid contamination.
- D. Remove film which may form on surface of material in containers and strain material before using. Stir frequently during use to maintain pigments in suspension. Do not stir film into material.
- E. Apply coatings of consistency recommended by manufacturer. Thin only within recommended limits using thinners approved by coating manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine conditions and proceed with work when conditions are acceptable. Beginning work shall indicate acceptance of substrates and underlying conditions.

- B. Measure moisture content of substrates using recently calibrated electronic moisture meter.
 - 1. Concrete and Plaster: 17 percent.
 - 2. Do not apply coatings if moisture content of surfaces exceeds lesser of percentages listed below or those required by coating manufacturer.
 - 3. If excess moisture content exists and cannot be reduced, obtain written approval of coating manufacturer before application of coatings.
- C. Prior to applying alkali and acid sensitive coatings, test surface pH with universal pH paper placed against wetted surface. Substrate pH shall not exceed pH of clean wash water.
- D. Beginning of execution constitutes acceptance of existing conditions.

3.02 PREPARATION - GENERAL

- A. Protect completed construction from damage. Furnish drop cloths, shields, and protective methods to prevent spray, splatter, or droppings from disfiguring other surfaces.
- B. Before beginning application of coatings, ensure surfaces are clean, dry, and free of dirt, dust, rust or rust scale, oil, grease, mold, mildew, algae, efflorescence, release agents, or any other foreign material which could adversely affect coating adhesion or finished appearance.

3.03 SURFACE PREPARATION FOR NEW WORK

- A. General:
 - 1. Correct minor defects.
 - 2. Remove temporary labels, wrappings, and protective coverings from surfaces to be coated.
 - 3. Seal stains, marks, and other imperfections which may bleed through surface finishes.
- B. Plaster:
 - 1. Allow surfaces to cure and dry completely prior to application of coatings; minimum of 28 days.
 - 2. Remove dirt, efflorescence, scale, loose sand, and powder by wire brushing or by other approved methods.
 - 3. Remove oil and grease with solution of TSP, rinse, and allow to dry.
 - 4. Wash portland cement plaster to receive solvent reducible coatings with zinc sulfate solution, rinse, and allow to dry.
 - 5. Fill hairline cracks, small holes and imperfections with latex patching plaster. Make smooth and flush with adjacent surfaces.
- C. Steel - Uncoated:
 - 1. Remove weld spatter by chipping or grinding.
 - 2. Clean interior and weather protected steel in accordance with SSPC-SP 2 and SSPC-SP 3. Clean areas of excessive corrosion or scale in accordance with SSPC-SP 7.
 - 3. Clean exterior steel permanently exposed to elements in accordance with SSPC-SP 6.
 - 4. Apply metal conditioner to bare surfaces in accordance with manufacturer's recommendations, paying particular attention to abrasions, welds, bolts, and nuts.
 - a. Allow to set as recommended by solution manufacturer.
 - b. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse.
 - c. Allow to dry.
 - 5. Prime coat immediately.

D. Steel - Prime Coated:

1. Remove loose primer and rust to feather-edge at adjacent sound primer by cleaning in accordance with SSPC-SP 2 and SSPC-SP 3.
2. Apply metal conditioner to abrasions, welds, bolts, and nuts in accordance with manufacturer's recommendations.
 - a. Allow to set as recommended by manufacturer.
 - b. Rinse with clean water with rust inhibitor mixed with water or applied immediately following rinse.
 - c. Allow to dry.
3. Prime coat bare areas immediately.
4. Apply specified primer to bare steel and previously primed steel surfaces including steel stair stringers and metal fabrications.

E. Steel - Galvanized:

1. Remove white rust by cleaning in accordance with SSPC-SP 2 and SSPC-SP 3. Exercise care not to remove galvanizing.
2. Pretreat surfaces to receive solvent reducible coatings immediately.

3.04 APPLICATION

A. General Requirements:

1. Coat all surfaces specified, scheduled, illustrated, and otherwise exposed unless specifically noted otherwise.
2. Apply coatings of type, color, and sheen as selected.
3. Apply products in accordance with Division 01. Use application materials, equipment, and techniques as recommended by coating manufacturer and best suited for substrate and type of material being applied.
4. Do not apply finishes to surfaces that are improperly prepared.
5. Number of coats specified are minimum number acceptable.
6. Apply coating systems to total dry film thickness scheduled.
 - a. Apply material at not less than manufacturer's recommended spreading rate.
 - b. Do not exceed maximum single coat thickness recommended by coating manufacturer.
 - c. Do not double-back with spray equipment building up film thickness of two coats in one pass.
7. Ensure that edges, corners, crevices, welds, and exposed fasteners receive dry film thickness equivalent of flat surfaces.
8. Finish edges of coatings adjoining other materials or colors sharp and clean, without overlapping.

B. Prime Coats:

1. Apply initial coat to surfaces as soon as practical after preparation and before subsequent surface deterioration.
2. Backprime exterior woodwork with specified primer.
3. Backprime interior woodwork scheduled to receive transparent finish with gloss varnish reduced 25 percent with mineral spirits.

4. Apply primer to wood and metal sash before field glazing.
- C. Intermediate and Top Coats:
 1. Allow previously applied coat to dry before next coat is applied.
 2. Sand and dust lightly between coats as recommended by coating manufacturer.
 3. Apply each coat to achieve uniform finish, color, appearance, and coverage free of brush and roller marks, runs, misses, visible laps or shadows, hazing, bubbles, pin holes, or other defects.
 4. If stains, undercoats, or other conditions show through final topcoat, correct defects and apply additional topcoats until coating film is of uniform finish, color, and appearance.
- D. Finish Matching:
 1. Finish closets same as adjoining rooms, unless otherwise specified.
 2. Finish tops, bottoms, and edges of doors same as door faces.
 - a. Apply sanding sealer to cut-outs.
 - b. When faces are different colors, finish edges of doors to match space from which they are visible when door is in partly open position.
 3. Finish other surfaces not specifically mentioned to match adjoining surfaces.
- E. Reinstall trim, fittings, and other items removed for finishing.

3.05 FIELD QUALITY CONTROL

- A. General: Comply with requirements of Section 01 40 00 - Quality Requirements.
- B. Periodically test film thickness of each coat with wet film gage to ensure coatings are being applied to proper thickness.
- C. Request review of each applied coat by Architect before application of successive coats. Only reviewed coats will be considered in determining number of coats applied.
- D. Immediately prior to Substantial Completion, perform detailed inspection of painted surfaces and repair or refinish abraded, stained, or otherwise disfigured surfaces.

3.06 CLEANING

- A. Promptly remove spilled, splashed, or spattered coatings. Clean spots, oil, and other soiling from finished surfaces using cleaning agents and methods which will not damage materials.
- B. If completed construction is damaged beyond normal cleaning or repair by painting operations, replace damaged items at no additional cost to Agency.
- C. Maintain premises and storage areas free of unnecessary accumulation of tools, equipment, surplus materials, and debris.
- D. Collect waste, cloths, and material which may constitute fire hazards and place in closed metal containers; remove from site daily along with empty containers.

3.07 PROTECTION

- A. Protect finished work in accordance with Division 1.
- B. Protect work of other trades against damage from coating activities. Correct damage by cleaning, repairing, replacing, and recoating as acceptable to Architect.
- C. Provide "Wet Paint" signs and other methods to protect newly coated surfaces. Remove when directed or when no longer needed.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

END OF SECTION

SECTION 12 2 00 WINDOW SHADES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Interior manual roller shades. WS-1.
- B. Interior motorized roller shades. WS-2.
- C. Motor controls.

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Concealed wood blocking for attachment of headrail brackets.
- B. Division 26 Electrical: Finish requirements for wall controls specified in this section.

1.03 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- B. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.
- C. CBC Ch. 11B - California Building Code-Chapter 11B.
- D. CBC Chapter 11B - California Building Code-Chapter 11B.
- E. NFPA 286 - Standard Methods of Fire Tests for Evaluating Contribution of Wall and Ceiling Interior Finish to Room Fire Growth.
- F. NFPA 70 - National Electrical Code.
- G. NFPA 701 - Standard Methods of Fire Tests for Flame Propagation of Textiles and Films.
- H. UL 325 - Standard for Door, Drapery, Gate, Louver, and Window Operators and Systems.
- I. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials.
- J. WCMA A100.1 - Standard for Safety of Window Covering Products.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Where motorized shades are to be controlled by control systems provided under other sections, coordinate the work with other trades to provide compatible products.
 - 2. Coordinate the work with other trades to provide rough-in of electrical wiring as required for installation of hardwired motorized shades.
- B. Preinstallation Meeting: Convene one week prior to commencing work related to products of this section; require attendance of affected installers.
- C. Sequencing:
 - 1. Do not fabricate shades until field dimensions for each opening have been taken with field conditions in place.
 - 2. Do not install shades until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets, including materials, finishes, fabrication details, dimensions, profiles, mounting requirements, and accessories.
 - 1. Motorized Shades: Include power requirements and standard wiring diagrams for specified products.
- C. Shop Drawings: Include shade schedule indicating size, location and keys to details, head, jamb and sill details, mounting dimension requirements for each product and condition, and operation direction.
 - 1. Motorized Shades: Provide schematic system riser diagram indicating component interconnections. Include requirements for interface with other systems.
- D. Certificates: Manufacturer's documentation that line voltage components are UL listed or UL recognized.
- E. Source Quality Control Submittals: Provide test reports indicating compliance with specified fabric properties.
- F. Selection Samples: Include fabric samples in full range of available colors and patterns.
 - 1. Motorized Shades: Include finish selections for controls.
- G. Verification Samples: Minimum size 6 inches square, representing actual materials, color and pattern.
- H. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- I. Project Record Documents: Record actual locations of control systems and show interconnecting wiring.
- J. Operation and Maintenance Data: List of all components with part numbers, sources of supply, and operation and maintenance instructions; include copy of shop drawings.
- K. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in District's name and registered with manufacturer.
- L. Maintenance contracts.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of this type with minimum three years of documented experience with shading systems of similar size and type.
 - 1. Manufacturer's authorized representative.
 - 2. Factory training and demonstrated experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 MOCK-UP

- A. Mock-Up: Provide full size mock-up of window shade system complete with selected shade fabric including example of seams and batten pockets when applicable.

1. Obtain Architect's approval of light and privacy characteristics of fabric prior to fabrication.
2. Full-sized mock-up may become part of the final installation.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver shades in manufacturer's unopened packaging, labeled to identify each shade for each opening.
- B. Handle and store shades in accordance with manufacturer's recommendations.

1.09 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.

1.10 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Provide manufacturer's warranty from Date of Substantial Completion, covering the following:
 1. Shade Hardware: One year.
 2. Electric Motors: One year.
 3. Electronic Control Equipment: One year.
 4. Fabric: One year.
 5. Aluminum and Steel Coatings: One year.

PART 2 PRODUCTS

2.01 ROLLER SHADES

- A. General:
 1. Provide shade system components that are easy to remove or adjust without removal of mounted shade brackets.
 2. Provide shade system that operates smoothly when shades are raised or lowered.
 3. Manual Window Shade Controls:
 - a. Unless where exempt per CBC Chapter 11B-203.9 Employee Workstations, manual window shade controls in classrooms, assemblies and other areas are required to accessible per CBC Ch. 11B-205 Operable Parts.
 4. Operation to comply with CBC Ch. 11B-309 Operable Parts.
 - a. Operable parts and controls at unobstructed forward and side approach shall be located within 48" a.f.f. to top of device. For reach requirements at other conditions, comply with CBC Ch. 11B-308 as they apply.
 - b. Operable parts shall be operable with one hand and shall not require tight grasping, pinching, or twisting of the wrist and shall have a maximum operable force of 5 lbs.
 - c. Operable parts shall also comply with CBC Ch. 11B-308.2, 11B-308.3. and 11B-309.4.
 5. Motorized Shades: Motor system housed inside roller tube, controlling shade movement via motor controls indicated; listed or recognized to UL 325.
 - a. Comply with CEC, and NFPA 70.

- b. Electrical Components: Listed, classified, and labeled as suitable for the purpose intended. Where applicable, system components to be FCC compliant.
 - c. Motors: Size and configuration as recommended by manufacturer for the type, size, and arrangement of shades to be operated; integrated into shade operating components and concealed from view; fully compatible with controls to be installed.
- B. Roller Shades - Basis of Design: MechoShade Systems LLC; Mecho/5 System; www.mechoshade.com/ sle.
- 1. Description: Single roller, manually operated fabric window shades.
 - a. Drop Position: Regular roll.
 - b. Mounting: Wall mounted.
 - c. Size: As indicated on drawings.
 - d. Fabric: As indicated under Shade Fabric article.
 - 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up size and weight.
 - a. Material: Steel, 1/8 inch thick.
 - 3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Size: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 - d. Capable of being removed and reinstalled without affecting roller shade limit adjustments.
 - 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
 - 5. Clutch Operator: Manufacturer's standard material and design integrated with bracket/brake assembly.
 - a. Provide a permanently lubricated brake assembly mounted on an oil-impregnated hub with wrapped spring clutch.
 - b. Brake must withstand minimum pull force of 50 lb in the stopped position.
 - c. Mount clutch/brake assembly on the support brackets, fully independent of the roller tube components.
 - 6. Drive Chain: Continuous loop stainless steel beaded ball chain, 95 lb minimum breaking strength. Provide upper and lower limit stops.
 - a. Chain Retainer: Chain tensioning device complying with WCMA A100.1.
 - 7. Managed Lift: Required lifting force of 3 lb to a maximum of 8.5 lb for single-band or multi-band shades up to 5 bands and a maximum of 30 lb hanging weight.
 - 8. Accessories:
 - a. Fascia: Extruded aluminum, size as required to conceal shade mounting, attachable to brackets without exposed fasteners; clear anodized finish.
 - 1) Color: As selected by Architect.

- 2) Profile: Square.
- 3) Configuration: Captured; fascia stops at bracket end.
- b. Fasteners: Noncorrosive, and as recommended by shade manufacturer.
- C. Roller Shades Type WS-1 - Basis of Design: MechoShade Systems LLC; ElectroShade with iQ2-DC EDU, low voltage, 24 VDC: www.mechoshade.com/ sle.
 1. Description: Single roller, motor-operated fabric window shade system complete with mounting brackets, roller tubes, hembars, hardware, and accessories.
 - a. Drop Position: Regular roll.
 - b. Mounting: Wall mounted.
 - c. Site: As indicated on drawings.
 - d. Fabric: As indicated under Shade Fabric article.
 2. Brackets and Mounting Hardware: As recommended by manufacturer for mounting indicated and to accommodate shade fabric roll-up site and weight.
 - a. Material: Steel, 1/8 inch thick.
 - b. Multiple Shade Operation: Provide hardware as necessary to operate more than one shade using a single motor.
 3. Roller Tubes:
 - a. Material: Extruded aluminum.
 - b. Site: As recommended by manufacturer; selected for suitability for installation conditions, span, and weight of shades.
 - c. Fabric Attachment: Utilize extruded channel in tube to accept vinyl spline welded to fabric edge. Shade band to be removable and replaceable without removing roller tube from brackets or inserting spline from the side of the roller tube.
 4. Hembars: Designed to maintain bottom of shade straight and flat.
 - a. Style: Full wrap fabric covered bottom bar, flat profile with heat sealed closed ends.
 5. Intelligent Encoded Electronic Drive System:
 - a. Low-Voltage EDU, 24 VDC:
 - 1) Audible Noise: 38 dBA or less measured 3 feet from motor unit, depending on motor torque.
 - 2) Capable of being configured to place motor into Override Mode when local switch commands shade to new position. Upon entering Override Mode, monitor and log positioning commands from automation devices, but do not act upon them until exiting Override Mode.
 - 3) Preventative Maintenance: Internally monitor important operating parameters to ensure motor and shade assembly are functioning properly.
 - b. Modes of Operation:
 - 1) Uniform Mode: Shades move only to defined intermediate stop positions to maintain aesthetic uniformity.
 - 2) Normal Mode: Shades move to defined intermediate stop positions plus any position between defined upper and lower limits.

- 3) Maintenance Mode: Prevent shade from moving to newly commanded positions via dry contact or network control commands until EDU has been serviced or Maintenance Mode has been cleared or disabled.
- c. Control Methods:
 - 1) Local isolated dry contact inputs support local switch control and third-party system integration without separate interface.
 - 2) Bidirectional network communication enables commanding operation of large groups of shades over common backbone.
 - 3) Provide minimum of three customi□able preset positions accessible over network connection and local dry contact control inputs.
 - 4) Provide minimum of 32 customi□able preset positions, including three local switch presets, accessible via network commands.
6. Accessories:
 - a. Fascia: Removable extruded aluminum fascia, si□e as required to conceal shade mounting, attachable to brackets without exposed fasteners; baked enamel finish.
 - 1) Capable of installation across two or more shade bands in one piece.
 - 2) Color: As selected by Architect.
 - 3) Profile: Square.
 - 4) Configuration: Captured and continuous, as indicated on drawings.
 - b. Fasteners: Noncorrosive, and as recommended by shade manufacturer.
- D. Roller Shades - Basis of Design: MechoShade Systems LLC; MagnaShade with WhisperShade IQ2 EDU, line voltage (120 VAC); www.mechoshade.com/ sle.
 1. Description: Single roller, motor operated fabric window shade system complete with mounting hardware, roller tubes, hembar, and accessories.
 2. Requirements:
 - a. Provide hardware that allows for removal and remounting of shade motor without removing shade roller tube or drive from the cassette support channel.
 - b. Provide shade hardware system that allows for field adjustment of EDU or replacement of operable hardware components without requiring removal of the installed cassette support channel.
 - c. Provide shade system that allows access below the motor head for setting or adjusting limits without disassembling the installed system.
 - d. Factory assemble components to the greatest extent possible.
 3. Drop Position: Regular roll.
 4. Mounting: Wall mounted.
 5. Si□e: As indicated on drawings.
 6. Fabric: As indicated under Shade Fabric article.
 7. Mounting Hardware:
 - a. Cassette Support Channel: Continuous channel attached to structure at manufacturer's recommended spacing; with bottom closure panel and end caps.

- b. Roller Shade Cradle: Prefabricated extruded aluminum cradle; clips into cassette support channel and fully supports shade assembly; low friction and wear-free surface.
 - c. Floating Hardware System: Manufacturer's standard device that attaches to motor mounting plate and roller tube and allows roller tube to move horizontally and vertically as the roll-up diameter of shade system increases or decreases during operation. Floating design ensures roller tube is straight, with no deflection.
8. Roller Tubes:
- a. Size: Not to exceed 2-1/2 inch diameter; selected for suitability for installation conditions, span, and weight of shades.
 - b. Fabric Attachment: Manufacturer's standard method for securing shade fabric to roller tube.
9. Hembars: Designed to maintain bottom of shade straight and flat.
10. Accessories:
- a. Fascia: Removable extruded aluminum fascia, size as required to conceal shade mounting, attached to cassette support channel without exposed fasteners; baked enamel finish.

2.02 SHADE FABRIC

- A. Fabric: Non-flammable, color-fast, impervious to heat and moisture, and able to retain its shape under normal operation.
- 1. Manufacturers:
 - a. MechoShade Systems LLC; ThermoVeil Basket Weave - 1500 Series (3 open) : www.mechoshade.com/ sle.
 - b. Phifer, Inc; Style 2390 5 : www.phifer.com/ sle.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
 - d. For any product not identified as "Basis of Design", submit information as specified for substitutions.
 - 2. Material: Vinyl coated polyester.
 - 3. Performance Requirements:
 - a. California Code of Regulations, Title 19 Section 3.08. Provide a nonflammable material, or treated and maintained in a flame-retardant condition by means of a flame-retardant solution or process approved by the State Fire Marshal, as set forth in California Code of Regulations, Title 19, Division 1, Chapter 8
 - b. Fire Performance: Class A per ASTM E84 or UL 723 Comply with CBC Section 803 and 806; Class A per NFPA 286,
 - c. Flammability: Pass NFPA 701 large and small tests.
 - d. Fungal Resistance: No growth when tested in accordance with ASTM G21.
 - 4. Openness Factor: 3 %.
 - 5. Roll Width: 72 inches.
 - 6. Color: As indicated on Drawings.
 - 7. Fabrication:
 - a. Fabric Orientation: Railroaded, fabric is turned 90 degrees off the roll.

- b. Battens: Full width of shade, enclose in welded shade fabric pocket.

2.03 MOTOR CONTROLS

- A. Unless specifically indicated to be excluded, provide all required equipment, conduit, boxes, wiring, connectors, hardware, supports, accessories, software, system programming, etc. as necessary for a complete operating system that provides the control intent indicated.
- B. Provide all components and connections necessary to interface with other systems as indicated.
- C. Digital Network Controls:
 - 1. Intelligent Motors and Devices: Identifiable over network without separate interface.
 - 2. Provide suitable interface modules as indicated or as required for connection to standard (nonintelligent) motors and devices.
 - 3. Capable of reprogrammed control without requiring wiring modifications.
 - 4. Capable of assigning shade motors to shade groups/sub-groups.
 - 5. Capable of storing programmable open and close limits and minimum of three intermediate preset stop positions for each shade.
 - 6. Capable of aligning adjacent shades within accuracy of plus/minus 0.25 inch.
 - 7. Provide 10 year nonvolatile power failure memory for system configuration settings.
 - 8. Basis of Design: MechoShade Systems LLC; MechoNet: www.mechoshade.com/ sle.
 - a. Low-voltage network utilizes standard Category 5/6 UTP cable; maximum of 4,000 feet, 250 nodes.
- D. Manual Motor Controls:
 - 1. Control Functions:
 - a. Open: Automatically open controlled shade(s) to fully open position when button is pressed.
 - b. Close: Automatically close controlled shade(s) to fully closed position when button is pressed.
 - c. Raise: Raise controlled shade(s) only while button is pressed.
 - d. Lower: Lower controlled shade(s) only while button is pressed.
 - e. Presets: For selection of predetermined shade positions.
 - f. Multiple Shade Groups: Provide individual controls for each shade group as indicated.
 - 2. Wall Controls: Provided by shade manufacturer.
 - a. Finish: To be selected by Architect.
 - b. Button Engraving: Manufacturer's standard engraving, unless otherwise indicated.

2.04 ROLLER SHADE FABRICATION

- A. Field measure finished openings prior to ordering or fabrication.
- B. Dimensional Tolerances: Fabricate shades to fit openings within specified tolerances.
 - 1. Vertical Dimensions: Fill openings from head to sill with 1/2 inch space between bottom bar and window stool.
 - 2. Horizontal Dimensions - Outside Mounting: Cover window frames, trim, and casings completely.

- C. Dimensional Tolerances: As recommended in writing by manufacturer.
- D. At openings requiring continuous multiple shade units with separate rollers, locate roller joints at window mullion centers; butt rollers end-to-end.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine finished openings for deficiencies that may preclude satisfactory installation.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Start of installation shall be considered acceptance of substrates.

3.02 PREPARATION

- A. Prepare surfaces using methods recommended by manufacturer for achieving best result for substrate under the project conditions.
- B. Coordinate with window installation and placement of concealed blocking to support shades.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions and approved shop drawings, using mounting devices as indicated.
- B. Adjust level, projection, and shade centering from mounting bracket. Verify there is no telescoping of shade fabric. Ensure smooth shade operation.

3.04 SYSTEM STARTUP

- A. Motorized Shade System: Provide services of a manufacturer's authorized representative to perform system startup.

3.05 CLEANING

- A. Clean soiled shades and exposed components as recommended by manufacturer.
- B. Replace shades that cannot be cleaned to "like new" condition.
- C. See Section 01 74 19 - Construction Waste Management and Disposal for additional requirements.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.
- B. See Section 01 79 00 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate operation and maintenance of window shade system to District's personnel.
- D. Training: Train District's personnel on operation and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours training by manufacturer's authorized personnel at location designated by the District.

3.07 PROTECTION

- A. Protect installed products from subsequent construction operations.
- B. Touch-up, repair, or replace damaged products before Substantial Completion.

3.08 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to District, a proposal as an alternate to the base bid, a separate renewable maintenance contract for the service and maintenance of a motorized shade system for two years from date of Substantial Completion. Include a complete description of preventive maintenance, systematic examination, adjustment, parts and labor, cleaning, and testing, with a detailed schedule.

END OF SECTION

SECTION 12 36 00 COUNTERTOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Countertops for architectural cabinetwork. SSM-1

1.02 RELATED REQUIREMENTS

- A. Section 06 10 00 - Rough Carpentry: Support framing, grounds, and concealed blocking.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design.
- B. ANSI A208.2 - Medium Density Fiberboard (MDF) for Interior Applications.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- D. AWMAC/WI (NAAWS) - North American Architectural Woodwork Standards.
- E. CBC Ch. 11B - California Building Code-Chapter 11B.
- F. ISFA 3-01 - Classification and Standards for Quartz Surfacing Material.
- G. NEMA LD 3 - High-Pressure Decorative Laminates.
- H. PS 1 - Structural Plywood.
- I. WI (CCP) - Certified Compliance Program (CCP).
- J. WI (MCP) - Monitored Compliance Program (MCP).

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- 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. Specimen warranty.
- C. Shop Drawings: Complete details of materials and installation.
 - 1. Provide the information required by AWMAC/WI (NAAWS) Architectural Woodwork Standards.
 - 2. Provide a Woodwork Institute Certified Compliance Label on the first page of the shop drawings.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.
- E. Verification Samples: For each finish product specified, minimum size 6 inches square, representing actual product, color, and patterns.
- F. Test Reports: Chemical resistance testing, showing compliance with specified requirements.
- G. Certificate: Submit labels and certificates required by quality assurance and quality control programs.

- H. Installer's qualification statement.
- I. Installation Instructions: Manufacturer's installation instructions and recommendations.
- J. Maintenance Data: Manufacturer's instructions and recommendations for maintenance and repair of countertop surfaces.

1.05 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of the type specified in this section, with not less than three years of documented experience.
- B. Quality Certification: Provide WI (MCP) inspection report and quality certification of completed work.
 - 1. Comply with WI (CCP) woodwork association quality certification service/program in accordance with requirements for work specified in this section:
www.woodworkinstitute.com/#sle.
 - 2. Provide labels or certificates indicating that the installed work complies with AWMAC/WI (NAAWS) requirements for grade or grades specified.
 - 3. Provide designated labels on shop drawings as required by certification program.
 - 4. Provide designated labels on installed products as required by certification program.
 - a. Before delivery to the jobsite the woodwork supplier shall provide a Woodwork Institute Certified Compliance Certificate indicating the millwork products being supplied and Certifying that these products fully meet the requirements of the Grade or Grades specified.
 - b. Provide a Woodwork Institute Certified Compliance Label on each Plastic Laminate, Solid Surface, and Solid Phenolic Core countertop.
 - 5. Submit certifications upon completion of installation that verifies this work is in compliance with specified requirements.
 - a. 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.
 - 6. All fees charged by the Woodwork Institute for their Certified Compliance program are the responsibility of the millwork manufacturer and/or installer and shall be included in the bid.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.07 FIELD 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.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

- B. Correct defective Work within a one year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty for material defects.

PART 2 PRODUCTS

2.01 COUNTERTOPS

- A. Quality Standard: Custom Grade, in accordance with AWMAC/WI (NAAWS), unless noted otherwise.
- B. Natural Quartz and Resin Composite Countertops: Sheet or slab of natural quartz and plastic resin over continuous substrate.
 - 1. Flat Sheet Thickness: 3/4 inch, minimum.
 - 2. Natural Quartz and Resin Composite Sheets, Slabs and Castings: Complying with ISFA 3-01 and NEMA LD 3; orthophthalic polyester resin, mineral filler, and pigments; homogenous, non-porous and capable of being worked and repaired using standard stone fabrication tools; no surface coating; color and pattern consistent throughout thickness.
 - a. SSM-1 Basis of Design Product: Everform as manufactured by Formica, or approved equal.
 - b. Manufacturers:
 - 1) DuPont Corporation; Zodiac: www2.dupont.com.
 - 2) LG Hausys; HI-MACS Quartz Surface: www.lghausys.com.
 - 3) Seieffe Corporation; OKITE®: www.okite.us/#sle.
 - 4) US Quartz Products Inc. (CaesarStone U.S.A., Inc.); Caesarstone: www.caesarstoneus.com
 - 5) Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
 - c. Factory fabricate components to the greatest extent practical in sizes and shapes indicated; comply with the MIA (DSDM).
 - d. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 - e. Finish on Exposed Surfaces: Polished.
 - f. Color and Pattern: As indicated on drawings.
 - 3. Other Components Thickness: 3/4 inch, minimum.
 - 4. Exposed Edge Treatment: Built up to minimum 1-1/4 inch thick; square edge.
 - 5. Back and End Splashes: Same sheet material, square top; minimum 4 inches high.
 - 6. Skirts: As indicated on drawings.
 - 7. Fabricate in accordance with manufacturer's standard requirements.

2.02 MATERIALS

- A. Plywood for Supporting Substrate: PS 1 Exterior Grade, A-C veneer grade, minimum 5-ply; minimum 3/4 inch thick; join lengths using metal splines.
- B. Medium Density Fiberboard for Supporting Substrate: ANSI A208.2.
- C. Adhesives: Chemical resistant waterproof adhesive as recommended by manufacturer of materials being joined.

1. Quartz / Resin Surfacing:
 - a. Mounting Adhesives:
 - 1) Provide structural-grade silicone or epoxy adhesives of type recommended by manufacturer for application and conditions of use.
 - 2) Acceptable Silicone Manufacturers:
 - (a) Dow Corning
 - (b) GE Sealants and Adhesives.
 - (c) Substitutions: See Section 01 60 00 - Product Requirements.
 - 3) Acceptable Epoxy Manufacturers:
 - (a) Akemi North America.
 - (b) Bonstone Material Corporation.
 - (c) Tenax USA.
 - 4) Provide spacers, if required, of type recommended by adhesive manufacturer.
 - D. Cleaning Agents: Non-abrasive, soft-scrub type kitchen cleansers.
 - E. Joint Sealant: Mildew-resistant silicone sealant, clear.

2.03 FABRICATION

- A. Fabricate according to Architectural Woodwork Standards Custom Grade.
- B. Fabricate tops and splashes in the largest sections practicable, with top surface of joints flush.
 1. Join lengths of tops using best method recommended by manufacturer.
 2. Fabricate to overhang fronts and ends of cabinets 1 inch except where top butts against cabinet or wall.
 3. Prepare all cutouts accurately to size; replace tops having improperly dimensioned or unnecessary cutouts or fixture holes.
- C. Provide back/end splash wherever counter edge abuts vertical surface unless otherwise indicated.
 1. Secure to countertop with concealed fasteners and with contact surfaces set in waterproof glue.
 2. Height: 4 inches, unless otherwise indicated.
- D. Solid Surfacing: Fabricate tops and wall panels up to 144 inches long in one piece; join pieces with adhesive sealant in accordance with manufacturer's recommendations and instructions.
 1. Finish exposed surfaces smooth and polish to a gloss sheen.
 2. Radius corners and edges.
 3. Cure components prior to shipment, except sheet materials requiring site handling.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
 1. Verify dimensions by field measurements prior to fabrication.
 2. Heights and clearances are to conform to ADA Standards and CBC Ch. 11B.
 3. Base Cabinets: Cabinet units shall be securely fixed to adjoining units and structure.

- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Verify that wall surfaces have been finished and mechanical and electrical services and outlets are installed in proper locations.
- D. Inspect finished surfaces for damage. Do not install until damage materials have been repaired in an acceptable manner or replaced.

3.02 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.
- C. Protect finished surfaces against scratches. Apply masking where necessary. Guard against grit, dust, and other trades.

3.03 INSTALLATION

- A. Securely attach countertops to cabinets using concealed fasteners. Make flat surfaces level; shim where required.
- B. Seal joint between back/end splashes and vertical surfaces.

3.04 TOLERANCES

- A. Variation From Horizontal: 1/16 inch in 1/16 feet, maximum.
- B. Offset From Wall, Countertops: 1/8 inch maximum; 1/16 inch minimum.
- C. Field Joints: 1/8 inch wide, maximum.
 - 1. Joints between backsplashes and countertops: Seal joints with silicone sealer.
 - 2. Joints Between Adjacent Pieces of Quartz Surfacing:
 - a. Joints shall be flush, tight fitting, level, and neat.
 - b. Securely join with stone adhesive. Fill joints level with quartz surfacing.
 - c. Clamp or brace quartz surfacing in position until adhesive sets.

3.05 CLEANING

- A. Remove masking and excess adhesives and sealants. Clean exposed surfaces.
- B. Clean countertops surfaces thoroughly.

3.06 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 12 93 13 BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Indoor bicycle racks.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete: Mounting surface for bicycle racks.

1.03 REFERENCE STANDARDS

- A. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2019.
- B. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless; 2022.
- C. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- E. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks and accessories with sufficient care to prevent scratches and other damage to the finish.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Indoor Bicycle Racks:
 - 1. Basis of Design: Classic Rack as manufactured by SteadyRack, www.steadyrack.com; or equal.

2. Bike Security Racks Company, Inc: www.bikeracks.com/#sle.
3. Ground Control Systems: www.groundcontrolsystems.com/#sle.
4. MADRAX, a brand of Graber Manufacturing, Inc: www.madrax.com/#sle.
5. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BICYCLE RACKS AND ACCESSORIES

- A. Indoor Bicycle Racks: Device designed for indoor storage of bicycles; allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 1. Style: Indoor, floor mounted and freestanding, single level and two level, vertical, double-sided storage rack with folding arms and locking loops.
 2. Style: Indoor, floor mounted and freestanding, single level and two level, vertical, single-sided storage rack with folding arms and locking loops.
 3. Capacity: As Indicated in Drawings.
 4. Finish: Powder coat, maintenance-free and weather-resistant.
 5. Color: As selected by Architect from manufacturer's standard range.
- B. Materials:
 1. Pipe: Carbon steel, ASTM A53/A53M, Schedule 40.
 2. Tube: Carbon steel, ASTM A500/A500M.
 3. Bar, Round and Flat, Carbon Steel: ASTM A36/A36M.
 4. Galvanizing of Carbon Steel Items: Galvanize after fabrication to ASTM A123/A123M requirements.
 5. Molded or Extruded Plastic: 100 percent, high-density, UV stabilized polyethylene.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive bicycle racks and accessories..
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Do not begin installation until unsatisfactory substrates have been properly repaired.
- D. Confirm that the required facility services have been provided and correctly installed before proceeding with installation of accessories.

3.02 PREPARATION

- A. Ensure surfaces to receive bicycle racks and accessories are clean, flat, and level.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install bicycle racks and accessories level, plumb, square, and correctly located as indicated on drawings.
- C. Coordinate installation of accessories with plumbing and electrical work by other trades.
- D. Post-Installed Anchors: Comply with ICC-ES AC308.

- E. Surface Flange Installation: Anchor bicycle racks and accessories securely in place with 1/2 inch by 4 inch anchor bolts through flange holes.
- F. Freestanding installation: Place in location indicated on drawings.

3.04 CLEANING

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 21 13 13

WET-PIPE FIRE SPRINKLER SYSTEM

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Work includes, but is not necessarily limited to, the following work areas:
1. Installation of a complete wet-pipe automatic fire sprinkler systems in all areas shown on plans including all interior compartments, exterior soffits (where required) and combustible concealed spaces if any.
 2. Compilation of record drawings by installing contractor, including all field changes and installing contractor's C-16 license number.
 3. Connection of interior fire sprinkler systems to site fire service laterals, at points of connection shown on fire protection and civil site plans.
 4. Test valves, drain lines, and all other inspection components.
 5. All coring, drilling, sleeving and chasing required for piping installation, as approved by Architect and Structural.
 6. Local audible alarm and connection points for central station monitoring, as shown on plans and as specified.
 7. Fees, permits, inspections and tests.
 8. Meetings and correspondence with project team members to confirm specific requirements for this project, including:
 - a. Location and methods of discharging water from test and drain connections.
 - b. Wiring and signaling requirements for alarm, detection and monitoring systems.

1.2 RELATED WORK IN OTHER SECTIONS

- | | |
|---|------------------|
| A. General Commissioning Requirements | Section 01 91 13 |
| B. Exterior Painting | Section 09 91 13 |
| C. Interior Painting | Section 09 91 23 |
| D. General Plumbing Provisions | Section 22 00 00 |
| E. Digital, Addressable Fire-Alarm System | Section 28 31 11 |
| Water Utilities | Section 33 14 16 |

1.3 QUALITY ASSURANCE

- A. Qualifications of Fabricators and Installers

1. For actual fabrication and installation of sprinkler systems, use only personnel who are thoroughly trained and experienced with the products involved, and in the recommended methods of their installation.
2. Installing contractor shall have a California C-16 license and be experienced in design and installation of systems in projects of similar size and scope.

1.4 REFERENCES

- A. In addition to complying with all pertinent standards, codes and regulations, comply with all requirements of:
 1. California Building Code, 2022 edition.
 2. California Fire Code, 2022 edition.
 3. State of California, Division of the State Architect.
 4. Santa Maria Fire Department requirements.
 5. Golden State Water Company requirements.
 6. NFPA 13, 24, 25 and 72 (as adopted by the State of California).
 7. ASCE 7 (2016 edition)
 8. Underwriters Laboratories (UL) and FM Global (FM) listed products.
 9. ICC Evaluation Service listed products.

1.5 SUBMITTALS

- A. Shop Drawings
 1. Within 30 days after award of Contract, submit shop drawings to the Architect for review. A complete submittal shall include the following:
 - a. Shop drawings shall be in compliance with approved plans.
 - b. Location of all switches, bells and electrical connections for alarm system, as described in this specification.
 - c. Location of connections to drain receptors for test and drain discharge.
 - d. Where revisions are proposed due to coordination with work of other trades, they shall be clearly illustrated and called out for review.
 - e. Where value-engineered revisions are proposed, they shall be clearly illustrated and called out for review.
 - f. Notations and identifying marks for fabrication may be included.
 2. Submit materials data sheets for all proposed product substitutions from the approved plans and data sheets. A statement of equivalency shall accompany items that are not exactly comparable to the approved product. Proposed substitutions of hanger and bracing materials shall only be allowed if submitted to and approved by DSA Fire Life Safety and Structural review with all required calculations and written acceptance by project structural engineer. Such substitutions shall be at the contractor's risk and at no additional expense to the owner.
- B. Maintenance Manual
 1. At close-out, submit maintenance manual describing maintenance schedules, replacement parts, and operational requirements.

C. Guarantee

1. Contractor shall guarantee fixed fire protection system, for a period of two years after date of final inspection, from leaks and other failures from materials and workmanship. Guarantee shall include repair of damage to Owner.

1.6 COORDINATION

- A. Coordinate work with that specified in other sections before start of installation. Any installation found to be in conflict with other trades due to neglected coordination, shall be removed and reinstalled as directed by the Architect at no additional expense to the Owner.
- B. Contractor shall contact the Architect and obtain necessary information to design fire sprinkler system to fit into allotted spaces without interfering with work by other trades.
- C. Coordinate with Plumbing section for size and location of drain receptors, where required or shown for draining and testing fire sprinkler risers and systems. All drain piping shall discharge into the receptors and not through walls or curbs, unless noted otherwise.

PART 2 - DESIGN AND MATERIALS

2.1 GENERAL DESIGN CRITERIA

- A. Coverage and Scope
 1. New Classroom building shall be protect for Light Hazard. Sprinklers shall be spaced at a maximum coverage of 225 sq. ft. for standard spray sprinklers or as shown on plans for sidewall or extended coverage sprinklers.
 2. Custodial and utility areas shall be protected for Ordinary Hazard. Sprinklers shall be spaced at a maximum coverage of 130 sq. ft. for standard spray sprinklers.
- B. System shall be designed using point of connection as shown on drawings, and as described in this specification.

2.2 MATERIALS AND PRODUCTS - GENERAL

- A. All material installed shall be approved and/or listed for fire protection use by the referenced authorities, codes and standards. All material shall be new and without field modifications.

2.3 SPRINKLERS

- A. General

1. All sprinklers shall be of similar make and appearance and shall have the same bulb or link and finish except where otherwise required by exposure to heat sources, freezing temperatures, corrosive environment, etc.
 - B. Interior Finished Ceilings and Exterior Soffits
 1. Provide recessed standard spray pendent, with white polyester finish and matching escutcheon.
 2. Listed corrosion-resistant sprinklers shall be installed at exterior areas, with white polyester or Teflon finish and matching escutcheon.
 - C. Concealed Areas, Unfinished Ceilings, and Service Areas
 1. Provide standard spray upright or pendent, with white finish.
 2. Where required, escutcheons shall be two-piece, style 401 with white painted finish at areas with ceilings.
 - D. Temperature Ratings and Response Type
 1. Sprinklers below finished ceilings, and in all other occupied areas shall have a temperature rating of Ordinary (155-165° F), except as noted below.
 - a. Sprinklers in unventilated spaces and under exterior canopies shall have a temperature rating of Intermediate (200-212° F).
 - b. Sprinklers in zone of influence of space heaters or other heat-producing equipment shall have a temperature rating of High (250-300° F), unless otherwise required by code.
 - c. All sprinklers shall be listed, quick-response type.
- 2.4 HANGERS AND SUPPORTS
- A. General
 1. Provide hangers approved by UL/FM and NFPA 13 for fire sprinkler systems. Shop fabricated supports shall be designed to meet requirements of NFPA 13, and must be certified by a registered professional engineer.
 2. Provide earthquake bracing in accordance with UL/FM, NFPA 13 and ASCE 7. Locations of all bracing shall be shown on shop drawings in conformance with approved plans. All bracing shall be assembled and installed per NFPA 13 and manufacturer's installation instructions.
 3. Size all anchors and fasteners per NFPA 13. All lag screws, bolts and drive screws shall be installed as required by codes and accepted good practices.
 4. All fasteners and/or anchors proposed for use in concrete construction shall be specifically listed and approved for use on fire sprinkler systems in seismic zones. Powder-driven studs shall not be used unless all system components including installation tool and pins are listed.

2.5 INTERIOR SPRINKLER PIPE AND FITTINGS

A. General

1. All pipe and fittings shall be new, acceptable to authorities having jurisdiction, per all applicable standards and codes, and free from damage and distortion.

B. Product Characteristics

1. Black steel, Schedule 40, ASTM A-53/135/795, for all piping, with threaded joints and fittings.
2. Black steel, Schedule 10, ASTM A-53/135/795, for all piping, with non-threaded joints and fittings.
3. Threaded fittings shall be of cast or malleable iron, class 125 or 150, conforming to ANSI B16.3 and ANSI B16.4.
4. Flanged fittings shall be provided where required. Flanges shall be of cast iron, class 125, conforming to ANSI B16.1.
5. Welded fittings shall be of wrought steel, conforming to ANSI B16.9.
6. One-piece reducing fittings shall be used wherever a change is made in pipe size. Bushings shall not be used, except where fittings of the required size are not available.
7. Grooved thinwall steel pipe connections shall be made using a UL/FM approved ductile iron coupling, with rubber gasket. Installation shall be per manufacturer's instructions.
8. All piping shall be joined with welded, threaded or grooved fittings. Fittings for hole-cut connections are not acceptable.

2.6 ACCESSORY CABINET

- A. Furnish metal sprinkler cabinet in riser room, with reserve supply of sprinklers as required by NFPA 13. Include one suitable head wrench for each type of sprinkler installed. Stock shall include all types and temperature ratings.

2.7 SIGNS

- A. Provide metal signage permanently marked to show function, for all valves, controls and related assemblies. Locate as required by NFPA 13 and authorities having jurisdiction. Where signs are required to identify valves or assemblies in hidden or void spaces, locate as directed by Architect.

2.8 PROTECTION OF SPRINKLERS

- A. Provide UL/FM listed guards for sprinkler heads located in areas susceptible to mechanical damage.

2.9 ESCUTCHEON PLATES

- A. Provide chrome-plated escutcheons where exposed piping penetrations are made through finished walls and ceilings. Plates shall be painted to resist corrosion when exterior installation is required.

2.10 LOCAL ALARM COMPONENTS

- A. Exterior Alarm Bell

1. Furnish 10" diameter, UL/FM approved bell with identification sign, rated 120VAC, with standard mounting hardware.
2. Locate as shown on approved plans.

B. Water Flow Switch

1. Provide UL/FM approved, 120VAC with two sets of Form C, single pole, double throw contacts, and adjustable retard feature.
2. Retard shall be set by Contractor so as to prevent false alarms, and still allow audible alarm within 30 seconds.

2.11 CENTRAL STATION SUPERVISION

A. General

1. Furnish supervision at all valves controlling fire protection water supplies, and any required underground conduit thereto.
2. Provide UL/FM approved tamper switch, Model PCVS-1, or OSYSU-1, or UL/FM listed equivalent, 120VAC with one set of Form C, single-pole, double-throw contacts.

2.12 FIRE DEPARTMENT CONNECTION

- A. Provide 4 " x 2 □", single or double clapper 2-way fire department connection. Finish and model shall be as required by serving fire department. Provide check valve per Section 2.14B.

2.13 VALVE COMPONENTS

A. Control Valve

1. Provide iron, double disc, bronze-mounted gate valve, with adjustable indicator post.
2. Post shall be compatible with valve, and be field painted as required by serving fire department.

B. Backflow Prevention and Check Valves

1. Check valves shall be iron body, bronze mounted, horizontal swing check. As acceptable to authorities having jurisdiction, iron body, bronze, disk wafer check may be used.
2. Check valve shall be U.L/FM approved for fire protection use, and recommended by the manufacturer for direct bury where such installation is to be required.
3. Iron body, bronze disk threaded or grooved swing check may be installed at Fire Department Connection, and located as acceptable to serving fire department.

C. Interior Drain/Test Valves

1. Furnish listed combination test and drain valve at riser, as shown on the approved plans. Provide pressure relief type, with bypass.

2. Where auxiliary drainage is required, provide brass, rubber disc, angle or globe pattern, with screwed ends, rated 200psi WOG.

2.14 VALVE CHART

- A. Provide chart in enclosed frame, indicating all valve locations functions.

2.15 UNDERGROUND PIPE AND FITTINGS

A. General

1. All pipe and fittings shall be new, acceptable to authorities having jurisdiction, comply with all applicable standards and codes, and free from damage and distortion.

B. Product Characteristics

1. Pipe shall be cast or ductile iron, or C-900 PVC, as shown on plans or required by water department. Pipe under structural footings shall be cast or ductile iron only, to at least 5'-0" beyond outside face of building.
2. Fittings shall be ductile iron, class 250, flanged or mechanical joints as required. Proper thrust restraint shall be provided per NFPA 24.
3. All hardware installed below-grade, including studs, bolts, nuts, washers, thrust-restraint rods, etc. shall be stainless steel conforming to UNS 31600 (formerly AISI Type 316). Hex-head bolts shall conform to ASTM F593, Alloy Group 2, Condition CW1/CW2 (depending on size). Hex nuts shall conform to ASTM F594, Alloy Group 2, Condition CW1/CW2 (depending on size). T-bolts shall be stamped to show conformance with UNS 31600.

PART 3 - EXECUTION

3.1 JOB SITE CONDITIONS

A. Inspection

1. Prior to all work of this section carefully inspect the installed work of other sections and verify that all such work is complete to the point where this portion of the work may properly commence in accordance with all submittals, designs, and applicable codes.

B. Discrepancies

1. In the event of a discrepancy, immediately notify the Architect. Do not proceed with installation in areas of discrepancy until all such discrepancies and/or omissions have been fully reviewed and clarified.

3.2 FABRICATION

A. General

1. All pipe, fittings, and materials shall be prepared by qualified personnel, trained and experienced with the products involved, and the recommended methods of preparation.
2. All pipe cuts, threads, and grooves shall be made according to applicable codes, standards and accepted good practices.
3. Pipe shall be free of damage, flaws and burrs. Threads and grooves shall not be excessively shallow or deep.
4. Fittings shall be made onto the pipe no tighter than necessary. Cracked or broken fittings shall be replaced, without exception.
5. Excess dope and oils shall be removed before shipment to job site.

B. Welding

1. Welding methods shall comply with NFPA 13 and AWS B2.1. Contractor shall be responsible for all welded joints and any qualifying procedures for welders and related personnel.
2. Holes in pipe for outlets shall be cut to full inside diameter of fitting, prior to welding in place. Holes shall be free of slag and welding residue and of smooth bore. Fittings shall not penetrate internal diameter of run piping. Holes shall be cut by hole-saw or other rotary bit. Torch-cutting of holes is prohibited.

3.3 INSTALLATION

A. General

1. All installations shall be per referenced standards. Follow manufacturer's directions and recommendations in all cases as required for all approvals and warranty enforcement.
2. All cutting of structure shall be subject to approval by the Architect. Beams, decks and other structural components shall not be cut or altered in any way unless previously approved.
3. Provide flexible couplings where required to provide expansion capability, and for earthquake protection per NFPA 13. Provide sway bracing as required by coupling locations.
4. Entire sprinkler system shall be installed in such a manner so that it can be drained in accordance with NFPA 13. Drains shall be located at suitable points as approved by Architect. No primary or auxiliary drain shall be located in any public area or electrical room. All drains shall discharge into dedicated receptors.
5. No work shall be covered or enclosed until inspected, tested, and approved by Architect and/or authority having jurisdiction. Should any work be concealed before inspection, the Contractor shall, at Contractor's expense, uncover such work and after it has been inspected, tested and approved, provide for all repairs as may be necessary to restore work to original and proper condition.
6. Sprinklers at finished ceilings and in exposed locations shall form a symmetrical pattern and shall be located at the exact centerline of 2' square ceiling tiles and "Second Look" tile modules. Where 2' x 4' ceilings occur, sprinklers shall be centered in the 2' direction with escutcheons at least 6" clear of ceiling T-bars.

7. In accordance with the requirements of ASCE 7, where suspended ceilings are not rigidly braced, penetrations of ceiling tiles by pendent sprinkler piping shall be provided with one of the following:
 - a. 1" annular space around the pipe or sprinkler (2" nominal larger hole).
 - b. A listed flexible hose connection, installed in accordance with manufacturer's instructions and NFPA 13, §9.2.1.3.3.
8. Sprinkler layout shall accommodate lighting and HVAC register locations. Coordination with the work of these sections is the responsibility of Contractor.
9. Without exception, no piping shall be run under or through any skylight or skylight well. Any additional upright or pendent sprinklers, which may be required by skylight locations, shall be the responsibility of this contractor.
10. All penetrations of wall and floor assemblies shall be suitably sleeved, patched and/or sealed in order to preserve fire rating, where applicable.
11. Location of control valves, fire department connection, and inspector's test shall be as required by authorities having jurisdiction, and as approved by Architect.
12. Local alarm bells shall be located so as to be easily heard and seen by passersby and fire department personnel. Locate on exterior wall, 10'-0" – 12'-0" above finished grade.
13. Provide wood or metal floor pans under and around pipe cutting/threading machines to protect floor surfaces from damage and discoloration.
14. Paint all fire sprinkler piping risers, drops and other components exposed to view in final construction as directed by Architect and per Section 09 91 23.
15. Underground pipe and fittings shall be installed per NFPA 24, and applicable local codes and standards. Trenching, back-filling, depth of bury and size, shape and location of all thrust blocks shall be acceptable to all jurisdictional agencies.

3.4 FIELD QUALITY CONTROL

A. Testing

1. Perform all tests as required by NFPA 13, and all authorities having jurisdiction. Maintain an accurate record of all tests and inspections on the job site, including date of test and inspecting agency.
2. Before connection of interior system to underground main, underground piping shall be hydrostatically tested, flushed and accepted by authorities having jurisdiction. Provide documentation of acceptance by jurisdictional authority. All required health and bacterial tests shall be the responsibility of Contractor.

3.5 COMPLETION

A. Closeout

1. Upon completion and approval of system, and prior to occupancy, provide instruction to the Owner, or Owner's representative, in all details of system operation and maintenance. Prepare and submit maintenance and operation manual per other sections of specifications as applicable.
2. Provide three copies of final inspection and certification as prescribed by Owner's Insurance Underwriter, and other authorities having jurisdiction.
3. Provide three (3) copies of system "As-Built" drawings to the Owner or Owner's representative. Drawings shall show actual installation details including all

piping and equipment locations, room or facilities modifications, etc. One (1) copy of drawings shall be on reproducible type media.

4. Furnish fully executed NFPA Materials and Test Certificate.
5. Submit two copies of guarantee per Section 017800.

B. Clean Up

1. Equipment, appurtenances, fixtures and exposed piping shall be clean, and all excess dope and oil shall be removed. Sprinkler heads shall be cleaned without the use of any solvents.
2. Upon completion of work, remove all surplus material, debris, and equipment associated with or used in the execution of this work. Sweep work and storage areas, as required, to remove metal shavings and oily residue.

END OF SECTION 21 13 13

SECTION 220513 - COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

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 general requirements for single-phase and polyphase, general-purpose, horizontal, small, and medium, squirrel-cage induction motors for use on alternating-current power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 ACTION SUBMITTALS

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

1.9 SUBMITTAL DATA

- A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".

- b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.10 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.11 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.12 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficient, as defined in NEMA MG 1.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.
 - 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.
- I. Insulation: Class F.
- J. Code Letter Designation:

1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
2. Motors Smaller Than 15 HP: Manufacturer's standard starting characteristic.

- K. Enclosure Material: Cast iron for motor frame sizes [324T] <Insert number> and larger; rolled steel for motor frame sizes smaller than [324T] <Insert number>.

2.4 ADDITIONAL REQUIREMENTS FOR POLYPHASE MOTORS

- A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
- B. Motors Used with Variable-Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width-modulated inverters.
 2. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 3. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
 2. Split phase.
 3. Capacitor start, inductor run.
 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 - EXECUTION (Not Applicable)

END OF SECTION 220513

SECTION 220516 - EXPANSION FITTINGS AND LOOPS FOR PLUMBING PIPING

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. Flexible-hose packless expansion joints.
 - 2. Metal-bellows packless expansion joints.
 - 3. Rubber packless expansion joints.
 - 4. Alignment guides and anchors.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

- D. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.5 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Delegated-Design Submittal: For each anchor and alignment guide, including analysis data, signed and sealed by the qualified professional engineer responsible for their preparation.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:

- a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
- b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
- c. Include all pertinent construction, installation, performance, and technical data.
- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the

Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.12 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For expansion joints to include in maintenance manuals.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.

- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressures, and temperatures.
- B. Capability: Products to absorb 200 percent of maximum axial movement between anchors.

2.2 PACKLESS EXPANSION JOINTS

- A. Flexible-Hose Packless Expansion Joints [**FHEJ-01**] <Insert drawing designation>:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flex Pression Ltd.
 - b. Flex-Hose Co., Inc.
 - c. Flexicraft Industries.
 - d. Mason Industries, Inc.
 - e. Metraflex Company (The).
 - f. Unisource Manufacturing, Inc.
 2. Description: Manufactured assembly with inlet and outlet elbow fittings and two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose.
 3. Flexible Hose: Corrugated-metal inner hoses and braided outer sheaths.
 4. Expansion Joints for Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with solder-joint end connections.
 - a. Bronze hoses and single-braid bronze sheaths with 450 psig at 70 deg F and 340 psig at 450 deg F ratings.
 - b. Bronze hoses and double-braid bronze sheaths with 700 psig at 70 deg F and 500 psig at 450 deg F ratings.
 5. Expansion Joints for Copper Tubing NPS 2-1/2 to NPS 4: Copper-alloy fittings with threaded end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 300 psig at 70 deg F and 225 psig at 450 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 420 psig at 70 deg F and 315 psig at 450 deg F ratings.
 6. Expansion Joints for Steel Piping NPS 2 and Smaller: Stainless-steel fittings with threaded end connections.

- a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 450 psig at 70 deg F and 325 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 700 psig at 70 deg F and 515 psig at 600 deg F ratings.
 - 7. Expansion Joints for Steel Piping NPS 2-1/2 to NPS 6: Carbon-steel fittings with flanged end connections.
 - a. Stainless-steel hoses and single-braid, stainless-steel sheaths with 200 psig at 70 deg F and 145 psig at 600 deg F ratings.
 - b. Stainless-steel hoses and double-braid, stainless-steel sheaths with 275 psig at 70 deg F and 200 psig at 600 deg F ratings.
- B. Metal-Bellows Packless Expansion Joints:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Adscio Manufacturing LLC.
 - b. American BOA, Inc.
 - c. Badger Industries, Inc.
 - d. Expansion Joint Systems, Inc.
 - e. Flex Pression Ltd.
 - f. Flex-Hose Co., Inc.
 - g. Flex-Weld, Inc.
 - h. Flexicraft Industries.
 - i. Flo Fab inc.
 - j. Hyspan Precision Products, Inc.
 - k. Mason Industries, Inc.
 - l. Metraflex Company (The).
 - m. Proco Products, Inc.
 - n. Senior Flexonics Pathway.
 - o. Tozen Corporation.
 - p. U.S. Bellows, Inc.
 - q. Unaflex.
 - r. Unisource Manufacturing, Inc.
 - s. Universal Metal Hose.
 - t. WahlcoMetroflex.
 - 2. Standards: ASTM F 1120 and EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
 - 3. Type: Circular, corrugated bellows with external tie rods.
 - 4. Minimum Pressure Rating: 150 psig unless otherwise indicated.
 - 5. Configuration: See details on drawings.
 - 6. Expansion Joints for Copper Tubing: See details on drawings.
 - a. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.
 - b. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint.
 - c. End Connections for Copper Tubing NPS 5 and Larger: Flanged.
 - 7. Expansion Joints for Steel Piping: Single or multi-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

- a. End Connections for Steel Pipe NPS 2 and Smaller: Threaded.
- b. End Connections for Steel Pipe NPS 2-1/2 and Larger: Flanged.

C. Rubber Packless Expansion Joints:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amber/Booth Company, Inc.
 - b. Flex-Hose Co., Inc.
 - c. Flex-Weld, Inc.
 - d. Flexicraft Industries.
 - e. Garlock Sealing Technologies.
 - f. General Rubber Corporation.
 - g. Mason Industries, Inc.
 - h. Metraflex Company (The).
 - i. Proco Products, Inc.
 - j. Red Valve Company, Inc.
 - k. Tozen Corporation.
 - l. Unaflex.
- 2. Standards: ASTM F1123 and FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- 3. Material: Fabric-reinforced rubber complying with FSA-PSJ-703.
- 4. Arch Type: See details on drawings.
- 5. Spherical Type: See details on drawings.
- 6. Minimum Pressure Rating for NPS 1-1/2 to NPS 12: 225 psig at 170 deg F.
- 7. Material for Fluids Containing Acids, Alkalis, or Chemicals: See details on drawings.
- 8. Material for Fluids Containing Gas, Hydrocarbons, or Oil: See details on drawings.
- 9. Material for Water: See details on drawings.
- 10. End Connections: Full-faced, integral steel flanges with steel retaining rings.

2.3 ALIGNMENT GUIDES AND ANCHORS

A. Alignment Guides:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Amber/Booth Company, Inc.
 - b. Adscos Manufacturing LLC.
 - c. Advanced Thermal Systems, Inc.
 - d. Flex-Hose Co., Inc.
 - e. Flex-Weld, Inc.
 - f. Flexicraft Industries.
 - g. Hyspan Precision Products, Inc.
- 2. Description: Steel, factory-fabricated alignment guide, with bolted two-section outer cylinder and base for attaching to structure; with two-section guiding slider for bolting to pipe.

B. Anchor Materials:

1. Steel Shapes and Plates: ASTM A36/A36M.
2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
3. Washers: ASTM F844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: Zinc-coated steel.
 - c. Washer and Nut: Zinc-coated steel.
5. Chemical Fasteners: Insert-type stud, bonding-system anchor for use with hardened portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Bonding Material: ASTM C881/C881M, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - b. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud, unless otherwise indicated.
 - c. Washer and Nut: Zinc-coated steel.

PART 3 - EXECUTION

3.1 INSTALLATION OF EXPANSION JOINTS

- A. Install expansion joints of sizes matching sizes of piping in which they are installed.
- B. Install metal-bellows expansion joints according to EJMA's "Standards of the Expansion Joint Manufacturers Association, Inc."
- C. Install rubber packless expansion joints according to FSA-PSJ-703.
- D. Install grooved-joint expansion joints to grooved-end steel piping.

3.2 INSTALLATION OF PIPE LOOP AND SWING CONNECTIONS

- A. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.
- B. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
- C. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.
- D. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.3 INSTALLATION OF ALIGNMENT-GUIDES AND ANCHORS

- A. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.

- B. Install two guide(s) on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- C. Attach guides to pipe, and secure guides to building structure.
- D. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.
- E. Anchor Attachments:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 2. Anchor Attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24; U bolts bolted to anchor.
- F. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1/D1.1M.
 - 1. Anchor Attachment to Steel Structural Members: Attach by welding.
 - 2. Anchor Attachment to Concrete Structural Members: Attach by fasteners. Follow fastener manufacturer's written instructions.
- G. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

END OF SECTION 22016

SECTION 220517 - SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

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. Sleeves.
 - 2. Stack-sleeve fittings.
 - 3. Sleeve-seal systems.
 - 4. Sleeve-seal fittings.
 - 5. Grout.
 - 6. Silicone sealants.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.7 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.8 ACTION SUBMITTALS

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

1.9 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the

system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.10 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.11 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.12 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.13 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Cast-Iron Pipe Sleeves: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop collar.
- B. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, anticorrosion coated or galvanized, with plain ends and integral welded waterstop collar.
- C. Galvanized-Steel Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- D. PVC Pipe Sleeves: ASTM D1785, Schedule 40.

- E. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- F. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 STACK-SLEEVE FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Zurn.
 - 2. JR Smith.
- B. Description: Manufactured, Dura-coated or Duco-coated galvanized cast-iron sleeve with integral clamping flange for use in waterproof floors and roofs. Include clamping ring, bolts, and nuts for membrane flashing.
 - 1. Underdeck Clamp: Clamping ring with setscrews.

2.3 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Metraflex Company (The).
 - 3. Pipeline Seal and Insulator, Inc.
- B. Description:
 - 1. Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
 - 2. Designed to form a hydrostatic seal of 20 psig minimum.
 - 3. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 4. Pressure Plates: Stainless steel.
 - 5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.4 SLEEVE-SEAL FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. Metraflex Company (The).
 - 3. Pipeline Seal and Insulator, Inc.
- B. Description: Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall.
- C. Plastic or rubber waterstop collar with center opening to match piping OD.

2.5 GROUT

- A. Description: Nonshrink, for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.6 SILICONE SEALANTS

- A. Silicone, S, NS, 25, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant, ASTM C920, Type S, Grade NS, Class 25, Use NT.
- B. Silicone, S, P, 25, T, NT: Single-component, pourable, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, neutral-curing silicone joint sealant; ASTM C920, Type S, Grade P, Class 25, Uses T and NT. Grade P Pourable (self-leveling) formulation is for opening in floors and other horizontal surfaces that are not fire rated.
- C. Silicone Foam: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

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 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. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. 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 above finished floor level.
 - 3. Using grout or silicone sealant, 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 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.
- E. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping and fill materials specified in Section 078413 "Penetration Firestopping."

3.2 STACK-SLEEVE-FITTING INSTALLATION

- A. Install stack-sleeve fittings in new slabs as slabs are constructed.
1. Install fittings that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
 2. Secure flashing between clamping flanges for pipes penetrating floors with membrane waterproofing. Comply with requirements for flashing specified in Section 076200 "Sheet Metal Flashing and Trim."
 3. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 4. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 5. Use silicone sealant to seal the space around outside of stack-sleeve fittings.
- B. Fire-Resistance-Rated Penetrations, Horizontal Assembly Penetrations, and Smoke Barrier Penetrations: Maintain indicated fire or smoke rating of floors at pipe penetrations. Seal pipe penetrations with fire- and smoke-stop materials. Comply with requirements for firestopping specified in Section 078413 "Penetration Firestopping."

3.3 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.

3.4 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Use grout or silicone sealant to seal the space around outside of sleeve-seal fittings.

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Leak Test: After allowing for a full cure, test sleeves and sleeve seals for leaks. Repair leaks and retest until no leaks exist.
- B. Sleeves and sleeve seals will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.6 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: Cast-iron pipe sleeves.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves.
 - 2. Exterior Concrete Walls below Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade:
 - a. Piping Smaller Than NPS 6: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - b. Piping NPS 6 and Larger: Cast-iron pipe sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade:
 - a. Piping Smaller Than NPS 6: Sleeve-seal fittings.
 - b. Piping NPS 6 and Larger: Steel pipe sleeves or Stack-sleeve fittings.
 - 5. Interior Partitions:

- a. Piping Smaller Than PS 6: Steel pipe sleeves.
- b. Piping NPS 6 and Larger: Galvanized-steel sheet sleeves.

END OF SECTION 220517

SECTION 220518 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
 - 2. Floor plates.

1.3 DEFINITIONS

- A. Existing Piping to Remain: Existing piping that is not to be removed and that is not otherwise indicated to be removed and salvaged, or removed and reinstalled.

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

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

1.11 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the

system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

- A. One-Piece, Steel Type: With polished, chrome-plated finish and setscrew fastener.
- B. One-Piece, Stainless-Steel Type: With polished stainless-steel finish.
- C. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.
- D. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished, chrome-plated finish and spring-clip fasteners.
- E. One-Piece, Stamped-Steel Type: With polished, chrome-plated finish and spring-clip fasteners.
- F. Split-Plate, Stamped-Steel Type: With polished, chrome-plated finish; concealed hinge; and spring-clip fasteners.

2.2 FLOOR PLATES

- A. Split Floor Plates: Cast brass with concealed hinge.

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 insulated piping and with OD that completely covers opening.
 - 1. Escutcheons for Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep pattern.
 - b. Chrome-Plated Piping: One-piece steel with polished, chrome-plated finish.
 - c. Insulated Piping: One-piece steel with polished, chrome-plated finish.
 - d. Insulated Piping: One-piece stainless steel with polished stainless-steel finish.
 - e. Insulated Piping: One-piece cast brass with polished, chrome-plated finish.
 - f. Insulated Piping: One-piece stamped steel with polished, chrome-plated finish.
 - g. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - h. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - i. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - j. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - k. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece steel with polished, chrome-plated finish.
 - l. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stainless steel with polished stainless-steel finish.
 - m. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece cast brass with polished, chrome-plated finish.
 - n. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - o. Bare Piping in Unfinished Service Spaces: One-piece steel with polished, chrome-plated finish.
 - p. Bare Piping in Unfinished Service Spaces: One-piece cast brass with polished, chrome-plated finish.
 - q. Bare Piping in Unfinished Service Spaces: One-piece stamped steel with polished, chrome-plated finish.
 - r. Bare Piping in Equipment Rooms: One-piece steel with polished, chrome-plated finish.
 - s. Bare Piping in Equipment Rooms: One-piece cast brass with polished, chrome-plated finish.
 - t. Bare Piping in Equipment Rooms: One-piece stamped steel with polished, chrome-plated finish.
 - 2. Escutcheons for Existing Piping to Remain:

- a. Chrome-Plated Piping: Split-casting, stamped steel with concealed hinge with polished, chrome-plated finish.
 - b. Insulated Piping: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish
 - c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - d. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - e. Bare Piping in Unfinished Service Spaces: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
 - f. Bare Piping in Equipment Rooms: Split-plate, stamped steel with concealed hinge with polished, chrome-plated finish.
- 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 and Relocated Existing Piping: One-piece, floor plate.
 - 2. Existing Piping: Split floor plate.

3.2 FIELD QUALITY CONTROL

- A. Using new materials, replace broken and damaged escutcheons and floor plates.

END OF SECTION 220518

SECTION 220519 - METERS AND GAGES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bimetallic-actuated thermometers.
2. Filled-system thermometers.
3. Liquid-in-glass thermometers.
4. Light-activated thermometers.
5. Thermowells.
6. Pressure gages.
7. Gage attachments.
8. Test plugs.
9. Test-plug kits.
10. Sight flow indicators.

B. Related Requirements:

1. Section 221119 "Domestic Water Piping Specialties" for water meters.
2. Section 331415 "Site Water Distribution Piping" for domestic water meters and combined domestic and fire-protection water-service meters outside the building.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.
5. California Division of the State Architect.
6. California State Division of Industrial Safety.
7. County Health Department.
8. Any other legally constituted body-having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.5 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.6 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor

shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.

- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.7 ACTION SUBMITTALS

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

1.8 SUBMITTAL DATA

- A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with

the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.9 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of meter and gage.

1.10 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For meters and gages to include in operation and maintenance manuals.

1.11 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.12 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.13 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 BIMETALLIC-ACTUATED THERMOMETERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ashcroft Inc.
 - 2. Ernst Flow Industries.
 - 3. Marsh Bellofram.
 - 4. Miljoco Corporation.
 - 5. Nanmac Corporation.
 - 6. Palmer Wahl Instrumentation Group.
 - 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
- B. Standard: ASME B40.200.

- C. Case: Liquid-filled and sealed type(s); stainless steel with 5-inch nominal diameter.
- D. Dial: Nonreflective aluminum with permanently etched scale markings and scales in deg F.
- E. Connector Type(s): Union joint, adjustable angle, with unified-inch screw threads.
- F. Connector Size: 1/2 inch, with ASME B1.1 screw threads.
- G. Stem: 0.25 or 0.375 inch in diameter; stainless steel.
- H. Window: Plain glass.
- I. Ring: Stainless steel.
- J. Element: Bimetal coil.
- K. Pointer: Dark-colored metal.
- L. Accuracy: Plus or minus 1 percent of scale range.

2.2 FILLED-SYSTEM THERMOMETERS

A. Direct-Mounted, Metal-Case, Vapor-Actuated Thermometers:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Terrice, H. O. Co.
 - g. Weiss Instruments, Inc.
- 2. Standard: ASME B40.200.
- 3. Case: Sealed type, cast aluminum or drawn steel; 5-inch nominal diameter.
- 4. Element: Bourdon tube or other type of pressure element.
- 5. Movement: Mechanical, dampening type, with link to pressure element and connection to pointer.
- 6. Dial: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
- 7. Pointer: Dark-colored metal.
- 8. Window: Glass.
- 9. Ring: Stainless steel.
- 10. Connector Type(s): Union joint, adjustable, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device; with ASME B1.1 screw threads.
- 11. Thermal System: Liquid-filled bulb in copper-plated steel, aluminum, or brass stem and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
- 12. Accuracy: Plus or minus 1 percent of scale range.

2.3 LIQUID-IN-GLASS THERMOMETERS

A. Metal-Case, Compact-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Terrice, H. O. Co.
 - g. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; 6-inch nominal size.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass or plastic.
8. Stem: Aluminum or brass and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
9. Connector: 3/4 inch, with ASME B1.1 screw threads.
10. Accuracy: Plus or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

B. Metal-Case, Industrial-Style, Liquid-in-Glass Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Ashcroft Inc.
 - b. Marsh Bellofram.
 - c. Miljoco Corporation.
 - d. Palmer Wahl Instrumentation Group.
 - e. REOTEMP Instrument Corporation.
 - f. Terrice, H. O. Co.
 - g. Weiss Instruments, Inc.
2. Standard: ASME B40.200.
3. Case: Cast aluminum; **7-inch** nominal size unless otherwise indicated.
4. Case Form: Straight unless otherwise indicated.
5. Tube: Glass with magnifying lens and blue organic liquid.
6. Tube Background: Nonreflective aluminum with permanently etched scale markings graduated in deg F.
7. Window: Glass.
8. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.

9. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
10. Accuracy: Plus, or minus 1 percent of scale range or one scale division, to a maximum of 1.5 percent of scale range.

2.4 LIGHT-ACTIVATED THERMOMETERS

A. Direct-Mounted, Light-Activated Thermometers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flo Fab Inc.
 - b. REOTEMP Instrument Corporation.
 - c. Terrice, H. O. Co.
 - d. Weiss Instruments, Inc.
 - e. WIKA Instrument Corporation - USA.
 - f. Winters Instruments - U.S.
2. Case: Metal; 7-inch nominal size unless otherwise indicated.
3. Scale(s): Deg F.
4. Case Form: Adjustable angle.
5. Connector: 1-1/4 inches, with ASME B1.1 screw threads.
6. Stem: Aluminum and of length to suit installation.
 - a. Design for Thermowell Installation: Bare stem.
7. Display: Digital.
8. Accuracy: Plus, or minus 2 deg F.

2.5 THERMOWELLS

A. Thermowells:

1. Standard: ASME B40.200.
2. Description: Pressure-tight, socket-type fitting made for insertion into piping tee fitting.
3. Material for Use with Copper Tubing: CNR or CUNI.
4. Material for Use with Steel Piping: CRES.
5. Type: Stepped shank unless straight or tapered shank is indicated.
6. External Threads: NPS 1/2, NPS 3/4, or NPS 1, ASME B1.20.1 pipe threads.
7. Internal Threads: 1/2, 3/4, and 1 inch, with ASME B1.1 screw threads.
8. Bore: Diameter required to match thermometer bulb or stem.
9. Insertion Length: Length required to match thermometer bulb or stem.
10. Lagging Extension: Include on thermowells for insulated piping and tubing.
11. Bushings: For converting size of thermowell's internal screw thread to size of thermometer connection.

B. Heat-Transfer Medium: Mixture of graphite and glycerin.

2.6 PRESSURE GAGES

A. Direct-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terrice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.
3. Case: Sealed type(s); cast aluminum or drawn steel 4-1/2-inch nominal diameter.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Brass.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

B. Remote-Mounted, Metal-Case, Dial-Type Pressure Gages:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMETEK, Inc.; U.S. Gauge.
 - b. Ashcroft Inc.
 - c. Ernst Flow Industries.
 - d. Flo Fab Inc.
 - e. Marsh Bellofram.
 - f. Miljoco Corporation.
 - g. Noshok.
 - h. Palmer Wahl Instrumentation Group.
 - i. REOTEMP Instrument Corporation.
 - j. Tel-Tru Manufacturing Company.
 - k. Terrice, H. O. Co.
 - l. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 - m. Weiss Instruments, Inc.
 - n. WIKA Instrument Corporation - USA.
 - o. Winters Instruments - U.S.
2. Standard: ASME B40.100.

3. Case: Sealed 4-1/2-inch nominal diameter with back flange and holes for panel mounting.
4. Pressure-Element Assembly: Bourdon tube unless otherwise indicated.
5. Pressure Connection: Brass, with NPS 1/2, ASME B1.20.1 pipe threads and bottom-outlet type unless back-outlet type is indicated.
6. Movement: Mechanical, with link to pressure element and connection to pointer.
7. Dial: Nonreflective aluminum with permanently etched scale markings graduated in psi.
8. Pointer: Dark-colored metal.
9. Window: Glass.
10. Ring: Metal.
11. Accuracy: Grade A, plus or minus 1 percent of middle half of scale range.

2.7 GAGE ATTACHMENTS

- A. Snubbers: ASME B40.100, brass; with NPS 1/2, ASME B1.20.1 pipe threads and piston-type surge-dampening device. Include extension for use on insulated piping.
- B. Valves: Brass ball, with NPS 1/2, ASME B1.20.1 pipe threads.

2.8 TEST PLUGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.
 5. Sisco Manufacturing Company, Inc.
 6. Trerice, H. O. Co.
 7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
 8. Weiss Instruments, Inc.
- B. Description: Test-station fitting made for insertion into piping tee fitting.
- C. Body: Brass or stainless steel with core inserts and gasketed and threaded cap. Include extended stem on units to be installed in insulated piping.
- D. Thread Size: NPS 1/4 or NPS 1/2, ASME B1.20.1 pipe thread.
- E. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F.
- F. Core Inserts: Chlorosulfonated polyethylene synthetic and EPDM self-sealing rubber.

2.9 TEST-PLUG KITS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Flow Design, Inc.
 2. Miljoco Corporation.
 3. National Meter, Inc.
 4. Peterson Equipment Co., Inc.

5. Sisco Manufacturing Company, Inc.
6. Trerice, H. O. Co.
7. Watts Regulator Co.; a div. of Watts Water Technologies, Inc.
8. Weiss Instruments, Inc.

- B. Furnish one test-plug kit containing one thermometer, one pressure gage and adapter, and carrying case. Thermometer sensing elements, pressure gage, and adapter probes shall be of diameter to fit test plugs and of length to project into piping.
- C. Low-Range Thermometer: Small, bimetallic insertion type with 1 to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 25 to 125 deg F.
- D. High-Range Thermometer: Small, bimetallic insertion type with 1 to 2-inch-diameter dial and tapered-end sensing element. Dial range shall be at least 0 to 220 deg F.
- E. Pressure Gage: Small, Bourdon-tube insertion type with 2 to 3-inch-diameter dial and probe. Dial range shall be at least 0 to 200 psig.
- F. Carrying Case: Metal or plastic, with formed instrument padding.

2.10 SIGHT FLOW INDICATORS

- A. Description: Piping inline-installation device for visual verification of flow.
- B. Construction: Bronze or stainless-steel body, with sight glass and ball, flapper, or paddle wheel indicator, and threaded or flanged ends.
- C. Minimum Pressure Rating: 150 psig.
- D. Minimum Temperature Rating: 200 deg F.
- E. End Connections for NPS 2 and Smaller: Threaded.
- F. End Connections for NPS 2-1/2 and Larger: Flanged.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees.
- B. Install thermowells of sizes required to match thermometer connectors. Include bushings if required to match sizes.
- C. Install thermowells with extension on insulated piping.
- D. Fill thermowells with heat-transfer medium.
- E. Install direct-mounted thermometers in thermowells and adjust vertical and tilted positions.

- F. Install remote-mounted thermometer bulbs in thermowells and install cases on panels; connect cases with tubing and support tubing to prevent kinks. Use minimum tubing length.
- G. Install direct-mounted pressure gages in piping tees with pressure gage located on pipe at the most readable position.
- H. Install remote-mounted pressure gages on panel.
- I. Install valve and snubber in piping for each pressure gage for fluids.
- J. Install test plugs in piping tees.
- K. Install thermometers in the following locations:
 - 1. Inlet and outlet of each water heater.
 - 2. Inlets and outlets of each domestic water heat exchanger.
 - 3. Inlet and outlet of each domestic hot-water storage tank.
 - 4. Inlet and outlet of each remote domestic water chiller.
- L. Install pressure gages in the following locations:
 - 1. Building water service entrance into building.
 - 2. Inlet and outlet of each pressure-reducing valve.
 - 3. Suction and discharge of each domestic water pump.

3.2 CONNECTIONS

- A. Install meters and gages adjacent to machines and equipment to allow service and maintenance of meters, gages, machines, and equipment.

3.3 ADJUSTING

- A. Adjust faces of meters and gages to proper angle for best visibility.

3.4 THERMOMETER SCHEDULE

- A. Thermometers at inlet and outlet of each domestic water heater shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Metal case, industrial-style, liquid-in-glass type.
 - 4. Direct-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Thermometers at inlets and outlets of each domestic water heat exchanger shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Metal case, industrial-style, liquid-in-glass type.
 - 4. Direct-mounted, light-activated type.

- 5. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- C. Thermometers at inlet and outlet of each domestic hot-water storage tank shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Metal case, industrial-style, liquid-in-glass type.
 - 4. Direct-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- D. Thermometers at inlet and outlet of each remote domestic water chiller shall be one of the following:
 - 1. Liquid-filled, bimetallic-actuated type.
 - 2. Direct-mounted, metal-case, vapor-actuated type.
 - 3. Metal case, industrial-style, liquid-in-glass type.
 - 4. Direct-mounted, light-activated type.
 - 5. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- E. Thermometer stems shall be of length to match thermowell insertion length.

3.5 THERMOMETER SCALE-RANGE SCHEDULE

- A. Scale Range for Domestic Cold-Water Piping:
 - 1. 0 to 150 deg F.
- B. Scale Range for Domestic Hot-Water Piping:
 - 1. 0 to 250 deg F.
- C. Scale Range for Domestic Cooled-Water Piping:
 - 1. 0 to 150 deg F.

3.6 PRESSURE-GAGE SCHEDULE

- 1. Liquid-filled direct-mounted, metal case.
- 2. Sealed, direct-mounted, plastic case.
- 3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- B. Pressure gages at inlet and outlet of each water pressure-reducing valve shall be one of the following:
 - 1. Liquid-filled direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.
- C. Pressure gages at suction and discharge of each domestic water pump shall be one of the following:
 - 1. Liquid-filled direct-mounted, metal case.
 - 2. Sealed, direct-mounted, plastic case.
 - 3. Test plug with chlorosulfonated polyethylene synthetic self-sealing rubber inserts.

3.7 PRESSURE-GAGE SCALE-RANGE SCHEDULE

A. Scale Range for Water Service Piping:

1. 0 to 100 psi.

B. Scale Range for Domestic Water Piping:

1. 0 to 100 psi.

END OF SECTION 220519

SECTION 220523 – GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Bronze ball valves.
2. Ductile-iron, single-flange butterfly valves.
3. Bronze lift check valves.
4. Bronze swing check valves.
5. Bronze gate valves.
6. Iron gate valves

1.2 DEFINITIONS

- A. CWP: Cold working pressure.
- B. RPTFE: Reinforced polytetrafluoroethylene.
- C. WOG: Water, oil, gas.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
1. C.C.R., Title 24, Part 5 (2022 CPC).
 2. 2022 California Plumbing Code.
 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 4. National Fire Protection Association.
 5. California Division of the State Architect.
 6. California State Division of Industrial Safety.
 7. County Health Department.
 8. Any other legally constituted body-having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of valve.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

- 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 DELIVERY, STORAGE, AND HANDLING

- A. Prepare valves for shipping as follows:
 - 1. Protect internal parts against rust and corrosion.
 - 2. Protect threads, flange faces, and soldered ends.
 - 3. Set ball valves open to minimize exposure of functional surfaces.
- B. 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.
- C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use operating handles or stems as lifting or rigging points.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of valve from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Standards:

- 1. Domestic water valves intended to convey or dispense water for human consumption must comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or must be certified to be in compliance with NSF 61 and NSF 372 (by an ANSI-accredited third-party certification body) that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

- B. ASME Compliance:

- 1. ASME B1.20.1 for threads for threaded end valves.
 - 2. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
 - 3. ASME B16.18 for cast copper solder-joint connections.
 - 4. ASME B16.22 for wrought copper and copper alloy solder-joint connections.
 - 5. ASME B16.34 for flanged and threaded end connections
 - 6. ASME B31.9 for building services piping valves.

- C. Provide bronze valves made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

- D. Valve Pressure-Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

- E. Valve Sizes: Same as upstream piping unless otherwise indicated.

- F. Valve Actuator Type:

- 1. Gear Actuator: For quarter-turn valves **NPS 4** and larger.
 - 2. Hand Lever: For quarter-turn valves smaller than NPS 4.

- G. Valves in Insulated Piping:

- 1. Provide 2-inch extended neck stems.
 - 2. Extended operating handles with nonthermal-conductive covering material and protective sleeves that allow operation of valves without breaking vapor seals or disturbing insulation.
 - 3. Memory stops that are fully adjustable after insulation is applied.

2.3 BRONZE BALL VALVES

- A. Three-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-595-Y-66-LF or T-595-Y-66-LF or a comparable product by one of the following,
 - a. Milwaukee Valve Company.
 - b. Apollo.
 - c. Watts LFB6800
 2. Description:
 - a. Standard: MSS SP-110, NSF 61-G.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Three piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - d. Body Material: Bronze ASTM B 584 Alloy C87850 or C87600.
 - e. Ends: Threaded or Solder.
 - f. Seats: PTFE or TFE.
 - g. Stem: 316 Stainless-steel.
 - h. Ball: 316 Stainless-steel, vented.
 - i. Port: Full.
- B. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim & Nib-Seal Handle:
1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-585-66-LF or T-585-66-LF or a comparable product by one of the following:
 - a. Industries, Inc.; Apollo Div.
 - b. Milwaukee Valve Company.
 - c. Watts LFFBV
 2. Description:
 - a. Standard: MSS SP-110, NSF 61-G.
 - b. CWP Rating: 600 psig.
 - c. Body Design: Two piece with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.
 - d. Body Material: Bronze ASTM B 584 Alloy C87600.
 - e. Ends: Threaded or Solder.
 - f. Seats: PTFE or TFE.
 - g. Stem: 316 Stainless-steel.
 - h. Ball: 316 Stainless-steel, vented.
 - i. Port: Full.
- C. 200 CWP, Sizes 2-1/2" – 24", Ductile Iron, Single-Flange Butterfly Valves with EPDM Seat and Aluminum-Bronze Disc:
1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model LD-2000-3/5, or a comparable product by one of the following:
 - a. Cooper Cameron Corp.; Cooper Cameron Valves Div.
 - b. Tyco International, Ltd.; Tyco Valves & Controls
 - c. Watts 2-DBF-03-121-15-M2

2. Description:
 - a. Standard: MSS SP-67, Type I, IAPMO.
 - b. NPS 24 (DN 300) and Smaller CWP Rating: 200 psig (1380 kPa).
 - c. Body Design: Full Lug type; Bubble tight shutoff, suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
 - d. Body Material: ASTM A 536, ductile iron.
 - e. Seat: EPDM.
 - f. Stem: One- or two-piece stainless steel.
 - g. Disc: Aluminum bronze

2.4 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-480-Y-LF or T-480-Y-LF or a comparable product by one of the following:
 - a. Hammond.
 - b. Milwaukee.
2. Description:
 - a. Standard: MSS SP-80, Type 2, NSF 61-G.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Vertical flow.
 - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE, or TFE.

2.5 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Nonmetallic TFE Disc:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-413-Y-LF or T-413-Y-LF or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - c. Watts 3/4 -LFWCVS
2. Description:
 - a. Standard: MSS SP-80, Type 4, NSF 61-G.
 - b. CWP Rating: 200 psig.
 - c. Body Design: Y-pattern Horizontal flow.
 - d. Body Material: ASTM B 584 Alloy C87850, lead free bronze.
 - e. Ends: Threaded or Solder.
 - f. Disc: PTFE or TFE.

2.6 BRONZE GATE VALVES

A. NRS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-113-LF or T-113-LF or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves.
 - c. Watts 1/2-LFWGV
2. Description:
 - a. Standard: MSS SP-139, Type 2, NSF 61-G.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B 584, dezincification-resistant bronze with integral seat and threaded bonnet.
 - d. Ends: Threaded or Solder.
 - e. Stem: Lead free Silicon Bronze.
 - f. Disc: Solid wedge; lead free bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

B. RS Bronze Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model S-111-LF or T-111-LF or a comparable product by one of the following:
 - a. Crane Co.; Crane Valve Group; Crane Valves.
 - b. Powell Valves
2. Description:
 - a. Standard: MSS SP-80, Type 2, NSF 61-G.
 - b. CWP Rating: 200 psig.
 - c. Body Material: ASTM B584 C87850 dezincification resistant bronze with integral seat and threaded bonnet.
 - d. Ends: Threaded or Solder.
 - e. Stem: Lead free silicon bronze.
 - f. Disc: Solid wedge, lead free bronze.
 - g. Packing: Asbestos free.
 - h. Handwheel: Malleable iron.

2.7 IRON GATE VALVES

A. Class 125, Ductile-Iron Resilient Wedge Gate Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-619-RWS (NRS) or F-607-RWS (OS&Y) or a comparable product by one of the following:
 - a. Clow
 - b. Mueller
 - c. Watts 408-OSYRW

2. Description:
- a. Standard: AWWA C-509 and C-515,
 - b. CWP Rating: 300 psig.
 - c. Body Material: ASTM A 536 ductile iron, fusion-bonded epoxy coating inside and out.
 - d. Ends: Flanged.
 - e. Trim: stainless-steel.
 - f. Disc: Rubber encapsulated ductile iron wedge.
 - g. Packing and Gasket: Asbestos free.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
- B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
- C. Examine threads on valve and mating pipe for form and cleanliness.
- D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.
- E. Do not attempt to repair defective valves; replace with new valves. Remove defective valves from site.

3.2 INSTALLATION OF VALVES

- A. Install valves with unions or flanges at each piece of equipment arranged to allow space for service, maintenance, and equipment removal without system shutdown.
- B. Provide support to piping adjacent to valves such that no force is imposed upon valves.
- C. Locate valves for easy access.
- D. For valves in horizontal piping, install valves with stem at or above center of pipe.
- E. Install valves in position to allow full valve actuation movement.
- F. Valve Tags: Comply with requirements in Section 220553 "Identification for Plumbing Piping and Equipment" for valve tags and schedules.
- G. Adhere to manufacturer's written installation instructions. When soldering or brazing valves, do not heat valves above maximum permitted temperature. Do not use solder with melting point temperature above valve manufacturer's recommended maximum.

3.3 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 exhibiting leakage.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

- A. If valves with specified CWP ratings are unavailable, provide the same types of valves with higher CWP ratings.
- B. Select valves with the following end connections:
 - 1. For Copper Tubing, NPS 2 and Smaller: Threaded ends except where solder-joint valve-end option or press-end option is indicated in valve schedules below.
 - 2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
 - 4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends except where threaded valve-end option is indicated in valve schedules below.
 - 6. For Steel Piping, NPS 5 and Larger: Flanged ends.
 - 7. For Stainless Steel Piping, NPS 2 and Smaller: Threaded ends.
 - 8. For Stainless Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
 - 9. For Stainless Steel Piping, NPS 2 and Smaller: Press ends.

3.5 LOW-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 PSIG OR LESS

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.
 - 2. Brass ball valves, one piece.
 - 3. Bronze ball valves, one piece with bronze trim.
 - 4. Brass ball valves, two piece with full port, and brass trim.
 - 5. Bronze ball valves, two piece with full port, and bronze or brass trim.
 - 6. Brass ball valves, three piece with full port, and brass trim.
 - 7. Bronze ball valve, three piece with full port, and bronze or brass trim.
 - 8. Bronze ball valves, two piece with regular port, and bronze trim.
- B. Pipe NPS 2-1/2 and Larger:
 - 1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
 - 2. Steel ball valves, Class 150 with full port.
 - 3. Iron ball valves, Class 150.

3.6 HIGH-PRESSURE, COMPRESSED-AIR VALVE SCHEDULE - 150 TO 200

- A. Pipe NPS 2 and Smaller:
 - 1. Bronze and Brass Valves: May be provided with solder-joint ends instead of threaded ends.

2. Brass ball valve.
3. Bronze ball valve, one piece with bronze trim.
4. Brass ball valves, two piece with full port, and brass trim.
5. Bronze ball valves, two piece with full port, and bronze or brass trim.
6. Brass ball valves, three piece with full port, and brass trim.
7. Bronze ball valves, three piece with full port, and bronze or brass trim.
8. Bronze ball valves, two piece with regular port, and bronze trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.

3.7 DOMESTIC HOT- AND COLD-WATER VALVE SCHEDULE

A. Pipe NPS 2 and Smaller:

1. Brass ball valve, one piece. Provide with solder joint ends.
2. Bronze ball valve, one piece with bronze trim. Provide with solder-joint ends.
3. Brass ball valves, two piece with full port, and brass trim. Provide with solder-joint ends.
4. Bronze ball valves, two piece with full port, and bronze or brass trim. Provide with solder-joint ends.
5. Brass ball valves, three piece with full port, and brass trim.
6. Bronze ball valves, three piece with full port, and bronze or brass trim.
7. Bronze ball valves, two piece with regular port, and bronze trim.

B. Pipe NPS 2-1/2 and Larger:

1. Steel and Iron Valves, NPS 2-1/2 to NPS 4: May be provided with threaded ends instead of flanged ends.
2. Steel ball valves, Class 150 with full port.
3. Iron ball valves, Class 150.
4. Stainless steel ball valves with flanged ends.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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. Metal 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 Requirements:
 - 1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
 - 2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 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.
- C. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
- D. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

- E. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.

1.5 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.6 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.
- C. Structural-Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M.
- D. Pipe Welding Qualifications: Qualify procedures and operators according to 2015 ASME Boiler and Pressure Vessel Code, Section IX.

1.7 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

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

2. Metal framing systems.
3. Fiberglass strut systems.
4. Pipe stands.
5. 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. Detail fabrication and assembly of trapeze hangers.
2. Include design calculations for designing trapeze hangers.

1.11 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 INFORMATIONAL SUBMITTALS

- A. Welding certificates.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design trapeze pipe hangers and equipment supports.
- 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, including pipe stands, 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.

2.2 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: Pregalvanized, hot-dip galvanized, or electro-galvanized.
3. Nonmetallic Coatings: Plastic coated or epoxy powder coated.
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 **stainless 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 and Tube 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**.

2.3 TRAPEZE PIPE HANGERS

- A. Description: MSS SP-58, 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.

2.4 THERMAL HANGER-SHIELD INSERTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. ERICO International Corporation.
2. PHS Industries, Inc.
3. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
4. Piping Technology & Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: ASTM C552, Type II cellular glass with 100-psig or ASTM C591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

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.

2.5 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 anchors, for use in hardened portland cement concrete, with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
 - 1. Indoor Applications: Zinc-coated or stainless steel.
 - 2. Outdoor Applications: Stainless steel.

2.6 PIPE STANDS

- A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to 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. Low-Profile, 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 channels.
 - 5. Pipe Supports: Clevis hanger.
 - 6. Hardware: Galvanized steel.
 - 7. Accessories: Protection pads.
 - 8. Height: 12 inches above roof.
- D. High-Profile, Single-Base, Single-Pipe Stand:
 - 1. Description: Single base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
 - 2. Base: Single vulcanized rubber or molded polypropylene.
 - 3. Vertical Members: Two galvanized-steel, continuous-thread, 1/2-inch rods.
 - 4. Horizontal Member: One adjustable-height, galvanized-steel, pipe-support slotted channel or plate.
 - 5. Pipe Supports: Clevis hanger.
 - 6. Hardware: Galvanized steel.
 - 7. Accessories: Protection pads, 1/2-inch, continuous-thread, galvanized-steel rod.
 - 8. Height: 36 inches above roof.

E. High-Profile, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: Two or more; **vulcanized rubber**.
3. Vertical Members: Two or more, galvanized-steel channels.
4. Horizontal Members: One or more, adjustable-height, galvanized-steel pipe support.
5. Pipe Supports: Clevis hanger.
6. Hardware: Galvanized steel.
7. Accessories: Protection pads, 1/2-inch, continuous-thread rod.
8. Height: 36 inches above roof.

F. Curb-Mounted-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE-POSITIONING SYSTEMS

- A. Description: IAPMO PS 42 positioning system composed of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

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

2.9 MATERIALS

- A. Aluminum: ASTM B221.
- B. Carbon Steel: ASTM A1011/A1011M.
- C. Structural Steel: ASTM A36/A36M carbon-steel plates, shapes, and bars; black and galvanized.
- D. Stainless Steel: ASTM A240/A240M.
- E. Grout: ASTM C1107/C1107M, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
 2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation, for penetrations through fire-rated walls, ceilings, and assemblies.

- B. Strength of Support Assemblies: Where not indicated, select sizes of components, so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Metal Pipe-Hanger Installation: Comply with MSS SP-58. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-58. 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 A36/A36M carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.
- C. Fiberglass Pipe-Hanger Installation: Comply with applicable portions of MSS SP-58. Install hangers and attachments as required to properly support piping from building structure.
- D. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.
- E. Thermal Hanger-Shield Installation: Install in pipe hanger or shield for insulated piping.
- F. Fastener System Installation:
 - 1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete, after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
 - 2. Install mechanical-expansion anchors in concrete, after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Pipe Stand Installation:
 - 1. Pipe Stand Types, except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
 - 2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.
- H. Pipe-Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.
- I. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.
- J. Equipment Support Installation: Fabricate from welded-structural-steel shapes.
- K. 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.

- L. Install lateral bracing with pipe hangers and supports to prevent swaying.
- M. 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 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.
- N. Load Distribution: Install hangers and supports, so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- O. 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.
- P. 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 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.
 - e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
 - 5. Pipes NPS 8 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 of 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 bearing surface smooth.

- 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/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.

3.5 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. Touchup: Clean field welds and abraded, shop-painted areas. Paint exposed areas immediately after erecting hangers and supports. Use same materials as those 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.
- B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded, shop-painted areas on miscellaneous metal are specified in Section 099113 "Exterior Painting," Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas, and apply galvanizing-repair paint to comply with ASTM A780/A780M.

3.7 HANGER AND SUPPORT SCHEDULE

- A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.
- B. Comply with MSS SP-58 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 finishes.
- 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, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.
- F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.
- G. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.
- H. Use padded hangers for piping that is subject to scratching.
- I. Use thermal hanger-shield inserts for insulated piping and tubing.
- J. 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 noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 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 noninsulated, stationary pipes NPS 3/4 to NPS 8.
 - 7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
 - 9. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
 - 10. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
 - 11. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
 - 12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
 - 13. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
 - 14. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
 - 15. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
 - 16. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction occurs.

17. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction occurs.
 18. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction occurs but vertical adjustment is unnecessary.
 19. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction occurs and vertical adjustment is unnecessary.
 20. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation, in addition to expansion and contraction, is required.
- K. 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.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.
- L. 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 of 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.
- M. 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. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. 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.
 - 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
 - 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
 - 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.
- N. 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.
- O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
- 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
 - 6. 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.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load, and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.
 - b. Vertical (MSS Type 55): Mounted vertically.
 - c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.
- P. Comply with MSS SP-58 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.
- Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.
- R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.
- S. Use pipe-positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Equipment labels.
2. Warning signs and labels.
3. Warning tape.
4. Pipe labels.
5. Stencils.
6. Valve tags.
7. Warning tags.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
1. C.C.R., Title 24, Part 5 (2022 CPC).
 2. 2022 California Plumbing Code.
 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 4. National Fire Protection Association.
 5. California Division of the State Architect.
 6. California State Division of Industrial Safety.
 7. County Health Department.
 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation

of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.

- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.5 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.6 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.7 ACTION SUBMITTALS

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

1.8 SUBMITTAL DATA

- A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

- B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

- a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
 3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
 4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
 5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
 6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.9 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.10 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.11 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

- A. Metal Labels for Equipment:
 - 1. Material and Thickness: Brass, 0.032-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Letter and Background Color: As indicated for specific application under Part 3.
 - 3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 5. Fasteners: Stainless steel rivets or self-tapping screws.
 - 6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- B. Plastic Labels for Equipment:
 - 1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
 - 2. Letter and Background Color: As indicated for specific application under Part 3.
 - 3. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
 - 4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 5. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances of up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 6. Fasteners: Stainless steel rivets or self-tapping screws.
 - 7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

2.2 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/8 inch thick, with predrilled holes for attachment hardware.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Maximum Temperature: Able to withstand temperatures of up to 160 deg F.
- D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- E. Minimum Letter Size: 1/4 inch (6.4 mm) for name of units if viewing distance is less than 24 inches (600 mm), 1/2 inch (13 mm) for viewing distances of up to 72 inches (1830 mm), and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- F. Fasteners: Stainless steel rivets or self-tapping screws.
- G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- H. Arc-Flash Warning Signs: Provide arc-flash warning signs in locations and with content in accordance with requirements of OSHA and NFPA 70E, and other applicable codes and standards.
- I. Label Content: Include caution and warning information plus emergency notification instructions.

2.3 WARNING TAPE

- A. Material: Vinyl.
- B. Minimum Thickness: 0.005 inch (0.12 mm).
- C. Letter, Pattern, and Background Color: As indicated for specific application under Part 3.
- D. Waterproof Adhesive Backing: Suitable for indoor or outdoor use.
- E. Maximum Temperature: 160 deg F (70 deg C).
- F. Minimum Width: [2 inches (50 mm)] [4 inches (100 mm)].

2.4 PIPE LABELS

- A. General Requirements for Manufactured Pipe Labels: Preprinted, color coded, with lettering indicating service and showing flow direction in accordance with ASME A13.1.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to [partially cover] [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.

- D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.
- E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings. Also include:
 - 1. Pipe size.
 - 2. Flow-Direction Arrows: Include flow-direction arrows on distribution piping. Arrows may be either integral with label or applied separately.
 - 3. Lettering Size: Size letters in accordance with ASME A13.1 for piping for viewing distances of up to 72 inches and proportionately larger lettering for greater viewing distances.

2.5 VALVE TAGS

- A. Description: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
 - 1. Tag Material: Brass, 0.04-inch minimum thickness, with predrilled or stamped holes for attachment hardware.
 - 2. Fasteners: Brass link chain or beaded chain.
- B. Letter and Background Color: As indicated for specific application under Part 3.
- C. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
 - 1. Include valve-tag schedule in operation and maintenance data.

2.6 WARNING TAGS

- A. Description: Preprinted accident-prevention tags of plasticized card stock.
 - 1. Size: 3 by 5-1/4 inches.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption, such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Letter and Background Color: As indicated for specific application under Part 3.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 INSTALLATION, GENERAL REQUIREMENTS

- 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. Locate identifying devices so that they are readily visible from the point of normal approach.

3.3 INSTALLATION OF EQUIPMENT LABELS, WARNING SIGNS, AND LABELS

- A. Permanently fasten labels on each item of plumbing equipment.
- B. Sign and Label Colors.
 - 1. White letters on an ANSI Z535.1 safety-green background.
- C. Locate equipment labels where accessible and visible.
- D. Arc-Flash Warning Signs: Provide arc-flash warning signs on electrical disconnects and other equipment where arc-flash hazard exists, as indicated on Drawings, and in accordance with requirements of OSHA and NFPA 70E[, **and other applicable codes and standards**].

3.4 INSTALLATION OF WARNING TAPE

- A. Warning Tape Color and Pattern: Yellow background with black diagonal stripes.
- B. Install warning tape on pipes and ducts, with cross-designated walkways providing less than 6 ft. of clearance.
- C. Locate tape so as to be readily visible from the point of normal approach.

3.5 INSTALLATION OF PIPE LABELS

- A. Piping Color Coding: Painting of piping is specified in Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."
- B. Install pipe labels showing service and flow direction with permanent adhesive on pipes.
- C. Stenciled Pipe Label Option: Stenciled labels showing service and flow direction may be provided instead of manufactured pipe labels, at Installer's option. Install stenciled pipe labels, complying with ASME A13.1, on each piping system.
 - 1. Identification Paint: Use for contrasting background.
 - 2. Stencil Paint: Use for pipe marking.

- D. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within 3 ft. of each valve and control device.
 2. At access doors, manholes, and similar access points that permit view of concealed piping.
 3. Within 3 ft. of equipment items and other points of origination and termination.
 4. Spaced at maximum intervals of **25 ft.** along each run. Reduce intervals to **10 ft.** in areas of congested piping and equipment.
- E. Do not apply plastic pipe labels or plastic tapes directly to bare pipes conveying fluids at temperatures of 125 deg F or higher. Where these pipes are to remain uninsulated, use a short section of insulation or use stenciled labels.
- F. Flow-Direction Flow Arrows: Use arrows, in compliance with ASME A13.1, to indicate direction of flow in pipes, including pipes where flow is allowed in both directions.
- G. Pipe-Label Color Schedule:
1. Low-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 2. High-Pressure Compressed-Air Piping: White letters on an ANSI Z535.1 safety-blue background.
 3. Vacuum Piping: White letters on an ANSI Z535.1 Safety blue background.
 4. Domestic Cold-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 5. Domestic Hot-Water Piping: White letters on an ANSI Z535.1 safety-green background.
 6. Domestic Hot-Water Return Piping White letters on an ANSI Z535.1 safety-green background.
 7. Sanitary Waste and Storm Drainage Piping: White letters on a black background.
 8. Nonpotable Cold Water: Black letters on an ANSI Z535.1 safety-yellow background.
 9. Nonpotable Hot Water: Black letters on an ANSI Z535.1-yellow background.
 10. Nonpotable Hot-Water Recirculation: Black letters on an ANSI Z535.1 safety-yellow background.
 11. Reagent Water Piping: White letters on an ANSI Z535.1 safety-blue background.
 12. Deionized Water Piping: White letters on an ANSI Z535.1 safety-blue background.
 13. Distilled Water Piping: White letters on an ANSI Z535.1 safety-blue background.
 14. Reverse Osmosis Water Piping: White letters on an ANSI Z535.1 safety-blue background.

3.6 INSTALLATION OF VALVE TAGS

- A. Install tags on valves and control devices in piping systems, except check valves, valves within factory-fabricated equipment units, shutoff valves, faucets, convenience and lawn-watering hose connections, and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule in the operating and maintenance manual.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in "Valve-Tag Size and Shape" Subparagraph below:
1. Valve-Tag Size and Shape:
 - a. Domestic Cold Water: 1-1/2 inches.
 - b. Domestic Hot Water: 1-1/2 inches.
 - c. Domestic Hot-Water Return: 1-1/2 inches.
 - d. Low-Pressure Compressed Air: 1-1/2 inches.
 - e. High-Pressure Compressed Air: 1-1/2 inches.
 - f. Nonpotable Cold Water: 1-1/2 inches.

- g. Nonpotable Hot Water: 1-1/2 inches.
- h. Nonpotable Hot-Water Return: 1-1/2 inches.
- i. Reagent Water Piping: 1-1/2 inches.
- j. Deionized Water Piping: 1-1/2 inches.
- k. Distilled Water Piping: 1-1/2 inches.
- l. Reverse Osmosis Water Piping: 1-1/2 inches.

2. Valve-Tag Colors:

- a. For each piping system, use the same lettering and background coloring system on valve tags as used in the piping system labels and background.

3.7 INSTALLATION OF WARNING TAGS

- A. Warning Tag Color: Black letters on an ANSI Z535.1 safety-yellow background.
- B. Attach warning tags, with proper message, to equipment and other items where indicated on Drawings or schedule.

END OF SECTION 220553

SECTION 220593 - TESTING, ADJUSTING, AND BALANCING FOR PLUMBING

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. TAB of domestic water system.
 - 2. TAB of plumbing equipment:
 - a. Domestic water booster pumps.
 - b. Domestic hot-water in-line circulation pumps.
 - c. General-duty air compressors.
 - d. Sanitary sewage pumps.
 - e. Drainage pumps.
 - f. Laboratory air compressors.
 - g. Laboratory vacuum pumps.
 - 3. Pipe-leakage test verification.
 - 4. Testing, adjusting, and balancing of existing plumbing systems and equipment.

1.3 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An independent entity meeting qualifications to perform TAB work.
- F. TDH: Total dynamic head.

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this

Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
1. C.C.R., Title 24, Part 5 (2022 CPC).
 2. 2022 California Plumbing Code.
 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 4. National Fire Protection Association.
 5. California Division of the State Architect.
 6. California State Division of Industrial Safety.
 7. County Health Department.
 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 PREINSTALLATION MEETINGS

- A. TAB Conference: Conduct a TAB conference at Project site after approval of the TAB strategies and procedures plan, to develop a mutual understanding of the details. Provide a minimum of 14 days' advance notice of scheduled meeting time and location.
1. Minimum Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Needs for coordination and cooperation of trades and subcontractors.
 - d. Proposed procedures for documentation and communication flow.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB specialist and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report, as specified in Part 3.
- C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures, as specified in "Preparation" Article.
- D. System Readiness Checklists: Within 30 days of Contractor's Notice to Proceed, submit system readiness checklists, as specified in "Preparation" Article.

- E. Examination Report: Submit a summary report of the examination review required in "Examination" Article.
- F. Certified TAB reports.
- G. Sample report forms.
- H. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.8 QUALITY ASSURANCE

- A. TAB Specialists Qualifications, Certified by AABC:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by AABC.
 - 2. TAB Technician: Employee of the TAB specialist and certified by AABC.
- B. TAB Specialists Qualifications, Certified by EBB or TABB:
 - 1. TAB Field Supervisor: Employee of the TAB specialist and certified by NEBB or TABB.
 - 2. TAB Technician: Employee of the TAB specialist and certified by NEBB or TABB.
- C. Instrumentation Type, Quantity, Accuracy, and Calibration: Comply with requirements in ASHRAE 111, Section 4, "Instrumentation."
- D. ASHRAE 111 Compliance: Requirements in ASHRAE 111 applicable to analogous domestic water system and plumbing equipment balancing.
- E. ASHRAE 188 Compliance: Comply with balancing and report requirements, Section 8.3 "Balancing."
- F. Code and Authorities Having Jurisdiction Compliance: TAB is required to comply with governing codes and requirements of authorities having jurisdiction.

1.9 FIELD CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, available TAB specialists that may be engaged include, but are not limited to, the following:

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems designs that may preclude proper TAB of systems and equipment.
- B. Examine installed systems for balancing devices, such as test ports, gauge cocks, thermometer wells, flow-control devices, and balancing valves and fittings. Verify that locations of these balancing devices are applicable for intended purpose and are accessible.
- C. Examine approved submittals for plumbing systems and equipment.
- D. Examine design data, including plumbing system descriptions, statements of design assumptions for environmental conditions and systems output, and statements of philosophies and assumptions about plumbing system and equipment controls.
- E. Examine equipment performance data, including pump curves.
 - 1. Relate performance data to Project conditions and requirements, including pump system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate pump system-effect factors to reduce performance ratings of plumbing equipment when installed under conditions different from the conditions used to rate equipment performance. Compare results with the design data and installed conditions.
- F. Examine system and equipment installations, and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine plumbing equipment and verify that bearings are greased, belts are aligned and tight, filters are clean, and equipment with functioning controls is ready for operation.
- I. Examine temporary and permanent strainers. Verify that temporary strainer screens used during system cleaning and flushing have been removed and permanent strainers are installed and clean.
- J. Examine control valves for proper installation for their intended function of isolating, throttling, diverting, or mixing fluid flows.
- K. Examine system pumps to ensure absence of entrained air in the suction piping.
- L. Examine operating safety interlocks and controls on plumbing equipment.

- M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes the following:
 - 1. Equipment and systems to be tested.
 - 2. Strategies and step-by-step procedures for balancing the systems.
 - 3. Instrumentation to be used.
 - 4. Sample forms with specific identification for all equipment.
- B. Perform system-readiness checks of plumbing systems and equipment to verify system readiness for TAB work. Include, at a minimum, the following:
 - 1. Domestic Water System:
 - a. Verify leakage and pressure tests on water distribution systems have been satisfactorily completed in accordance with applicable code and authority having jurisdiction.
 - b. Water heaters are installed and functioning.
 - c. Piping is complete and all points of outlet are installed.
 - d. Water treatment is complete.
 - e. Systems are flushed, filled, and air purged.
 - f. Strainers are clean.
 - g. Control valves are functioning in accordance with the sequence of operation.
 - h. Shutoff and balance valves are 100 percent open.
 - i. Booster- and hot-water circulating pumps are operational and proper rotation is verified.
 - j. Pump gauge connections are installed directly at pump inlet and outlet flanges or in discharge and suction pipe prior to valves or strainers.
 - k. Variable-frequency controllers' startup is complete, and safeties are verified.
 - l. Suitable access to balancing devices and equipment is provided.
 - 2. Sanitary Sewage/Drainage System:
 - a. Leakage and pressure tests on sanitary sewage/drainage systems have been completed in accordance with applicable code and authority having jurisdiction requirements.
 - b. Piping is complete.
 - c. Sanitary sewage pumps/drainage pumps are operational.
 - d. Control valves are functioning in accordance with the sequence of operation.
 - e. Shutoff valves are 100 percent open.
 - f. Suitable access to equipment is provided.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system in accordance with the procedures contained in ASHRAE 111 and in this Section.
- B. Cut insulation, pipes, and equipment casings for installation of test probes to the minimum extent necessary for TAB procedures.

1. Where holes for probes are required in piping or equipment, install pressure and temperature test plugs to seal systems.
 2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish in accordance with Section 220716 "Plumbing Equipment Insulation" and Section 220719 "Plumbing Piping Insulation."
- C. Mark equipment and balancing devices, including valve position indicators and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR PLUMBING EQUIPMENT

- A. Test, adjust, and balance plumbing equipment indicated on Drawings, including, but not limited to, the following:
1. Motors.
 2. Domestic water in-line pumps.
 3. Domestic water heaters.

3.6 PROCEDURES FOR DOMESTIC WATER SYSTEMS

- A. Prepare test reports for pumps and other equipment. Obtain approved submittals and manufacturer-recommended testing procedures. Crosscheck the summation of required equipment flow rates with system design flow rates.
- B. Prepare schematic diagrams of systems' Record drawings piping layouts.
- C. In addition to requirements in "Preparation" Article, prepare domestic water systems for testing and balancing as follows:
1. Check expansion tank for proper setting.
 2. Check water heater for proper discharge temperature setting.
 3. Check remotest point of outlet for adequate pressure.
 4. Check flow-control valves for proper position.
 5. Locate start-stop and disconnect switches, electrical interlocks, and motor controllers.
 6. Verify that motor controllers are equipped with properly sized thermal protection.
 7. Check that air has been purged from the system.
- D. Measure and record upstream and downstream pressure of each piece of equipment.
- E. Measure and record upstream and downstream pressure of pressure-reducing valves.
- F. Check settings and operation of automatic temperature-control valves, self-contained control valves, and pressure-reducing valves. Record final settings.
- G. Check settings and operation of each safety valve. Record settings.

3.7 PROCEDURES FOR DOMESTIC HOT-WATER CIRCULATING INLINE PUMP

- A. Balance system with manual or automatic balancing valves by setting at design flow.
 - 1. Measure flow in main and branch pipes.
 - 2. Adjust main and branch balance valves for design flow.
 - 3. Re-measure each main and branch after all have been adjusted.
- B. Adjust pump to deliver total design flow.
 - 1. Measure pump TDH as follows:
 - a. Measure discharge pressure directly at the pump outlet flange or in discharge pipe prior to any valves.
 - b. Measure inlet pressure directly at the pump inlet flange or in suction pipe prior to any valves or strainers.
 - c. Convert pressure to head and correct for differences in gauge heights.
 - d. Verify pump impeller size by measuring the TDH with the discharge valve closed. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
 - 2. Monitor motor performance during procedures, and do not operate motor in an overloaded condition.
 - 3. Mark final settings and verify that all memory stops have been set.
 - 4. Verify final system conditions as follows:
 - a. Re-measure and confirm that total flow is within design.
 - b. Re-measure final pumps' operating data, TDH, volts, amps, speed, and static profile.
 - c. Mark final settings.

3.8 PROCEDURES FOR MOTORS

- A. Motors 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Phase and hertz.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter size and thermal-protection-element rating.
 - 8. Service factor and frame size.
- B. Motors Driven by Variable-Frequency Controllers: Test manual bypass of controller to prove proper operation.

3.9 PROCEDURES FOR WATER HEATERS

- A. Electric Water Heaters:
 - 1. Measure and record entering- and leaving-water temperatures.

2. Measure and record water flow.
3. Measure and record pressure drop.
4. Measure and Record relief valve(s) pressure setting.
5. Capacity: Calculate in Btu/h of heating output.
6. Efficiency: Calculate operating efficiency for comparison to submitted equipment.

3.10 TOLERANCES

- A. Set plumbing system's flow rates within the following tolerances:
1. Domestic Water Flow Rate: Plus, or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
 2. Compressed-Air Flow Rate: Plus, or minus 5 percent. If design value is less than 10 gpm, within 10 percent.
 3. Vacuum Flow Rate: Plus, or minus 5 percent.

3.11 PROGRESS REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for system-balancing devices. Recommend changes and additions to system-balancing devices, to facilitate proper performance measuring and balancing. Recommend changes and additions to plumbing systems and general construction to allow access for performance-measuring and -balancing devices.
- B. Status Reports: Prepare [weekly] [biweekly] [monthly] <Insert time interval> progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.12 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 2. Include a list of instruments used for procedures, along with proof of calibration.
 3. Certify validity and accuracy of field data.
- B. Final Report Contents: In addition to certified field-report data, include the following:
1. Pump curves.
 2. Manufacturers' test data.
 3. Field test reports prepared by system and equipment installers.
 4. Other information relative to equipment performance; do not include Shop Drawings and Product Data.
- C. General Report Data: In addition to form titles and entries, include the following data:
1. Title page.

2. Name and address of the TAB specialist.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Report date.
 9. Signature of TAB supervisor who certifies the report.
 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 11. Summary of contents, including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for pump performance forms, including the following:
 - a. Variable-frequency controller settings for variable-flow hydronic systems.
 - b. Settings for pressure controller(s).
 - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of distribution systems. Present each system with single-line diagram and include the following:
1. Flow rates.
 2. Pipe and valve sizes and locations.
 3. Balancing stations.
 4. Position of balancing devices.
- E. Electric Water Heater Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Model number and unit size.
 - d. Manufacturer's serial number.
 - e. Output capacity in Btu/h.
 - f. Number of stages.
 - g. Connected volts, phase, and hertz.
 - h. Rated amperage.
 2. Test Data (Indicated and Actual Values):
 - a. Heat output in Btu/h.
 - b. Entering-water temperature in deg F.
 - c. Leaving-water temperature in deg F.
 - d. High-temperature-limit setting in deg F.
 - e. Operating set point in deg F.

- f. Voltage at each connection.
- g. Amperage for each phase.

F. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves, and include the following:

1. Unit Data:

- a. Unit identification.
- b. Location.
- c. Service.
- d. Make and size.
- e. Model number and serial number.
- f. Water flow rate in gpm.
- g. Water-pressure differential in feet of head or psig.
- h. Required net positive suction head in feet of head or psig.
- i. Pump speed.
- j. Impeller diameter in inches.
- k. Motor make and frame size.
- l. Motor horsepower and rpm.
- m. Voltage at each connection.
- n. Amperage for each phase.
- o. Full-load amperage and service factor.
- p. Seal type.

2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
- b. Pump shutoff pressure in feet of head or psig.
- c. Actual impeller size in inches.
- d. Full-open flow rate in gpm.
- e. Full-open pressure in feet of head or psig.
- f. Final discharge pressure in feet of head or psig.
- g. Final suction pressure in feet of head or psig.
- h. Final total pressure in feet of head or psig.
- i. Final water flow rate in gpm.
- j. Voltage at each connection.
- k. Amperage for each phase.

G. Instrument Calibration Reports:

1. Report Data:

- a. Instrument type and make.
- b. Serial number.
- c. Application.
- d. Dates of use.
- e. Dates of calibration.

3.13 VERIFICATION OF TAB REPORT

- A. The TAB specialist's test and balance engineer shall conduct the inspection in the presence of Architect, Owner, Construction Manager, and/or Commissioning Authority.
- B. Architect, Owner, Construction Manager, and/or Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to the lesser of either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
- C. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
- D. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the TAB shall be considered incomplete and shall be rejected.
- E. If recheck measurements find the number of failed measurements noncompliant with requirements indicated, proceed as follows:
 - 1. TAB specialists shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection. All changes shall be tracked to show changes made to previous report.
 - 2. If the second final inspection also fails, Owner may pursue other Contract options to complete TAB work.
- F. Prepare test and inspection reports.

3.14 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

END OF SECTION 220593

SECTION 220719 - PLUMBING PIPING INSULATION

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes insulating the following plumbing piping services:
 - 1. Domestic hot-water piping.
 - 2. Domestic recirculating hot-water piping.
 - 3. Supplies and drains for handicap-accessible lavatories and sinks.
 - 4. Condensate drainage for mechanical units.
- B. Related Sections:
 - 1. Section 220716 "Plumbing Equipment Insulation" for equipment insulation.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
 - 9. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories or sinks. CBC Section 11B-606.5.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

- C. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.
- D. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the location indicated or, if not indicated, as directed by Architect. Use materials indicated for the completed Work.
 - 1. Piping Mockups:
 - a. One 10-foot section of NPS 2 straight pipe.
 - b. One each of a 90-degree threaded, welded, and flanged elbow.
 - c. One each of a threaded, welded, and flanged tee fitting.
 - d. One NPS 2 or smaller valve and one NPS 2-1/2 or larger valve.
 - e. Four support hangers, including hanger shield and insert.
 - f. One threaded strainer and one flanged strainer with removable portion of insulation.
 - g. One threaded reducer and one welded reducer.
 - h. One pressure temperature tap.
 - i. One mechanical coupling.
 - j. One union.
 - 2. For each mockup, fabricate cutaway sections to allow observation of application details for insulation materials, adhesives, mastics, attachments, and jackets.
 - 3. Notify Architect [seven] <Insert number> days in advance of dates and times when mockups will be constructed.
 - 4. Obtain Architect's approval of mockups before starting insulation application.
 - 5. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 - 6. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 - 7. Demolish and remove mockups when directed.
- E. Comply with the following applicable standards and other requirements specified for miscellaneous components:
 - 1. Supply and Drain Protective Shielding Guards: ICC A117.1.

1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.

- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.5 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.6 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.7 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).
- B. 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 insulation application at pipe expansion joints for each type of insulation.
 4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
 5. Detail removable insulation at piping specialties, equipment connections, and access panels.
 6. Detail application of field-applied jackets.
 7. Detail application at linkages of control devices.
- 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 long by NPS 2.
 2. Jacket Materials for Pipe: 12 inches long by NPS 2.
 3. Sheet Jacket Materials: 12 inches 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.

1.8 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.

- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.9 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.

- B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.
- C. Field quality-control reports.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation system materials are to be delivered to the Project site in unopened containers. The packaging is to include name of the manufacturer, fabricator, type, description, and size[, **as well as ASTM standard designation and maximum use temperature**].

1.11 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.12 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products in accordance with ASTM E84, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation, jacket materials, adhesive, mastic, tapes, and cement material containers with appropriate markings of applicable testing agency.
 - 1. All Insulation Installed Indoors and Outdoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

2.2 INSULATION MATERIALS

- A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials are applied.
- B. Products do not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come into contact with stainless steel have a leachable chloride content of less than 50 ppm when tested in accordance with ASTM C871.
- D. Insulation materials for use on austenitic stainless steel are qualified as acceptable in accordance with ASTM C795.
- E. Foam insulation materials do not use CFC or HCFC blowing agents in the manufacturing process.
- F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Comply with ASTM C552.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Johns Manville; Micro-Lok.
 - b. Owens Corning; Fiberglas Pipe Insulation.
2. Preformed Pipe Insulation, Type II, Class 1: Unfaced.
3. Preformed Pipe Insulation, Type II, Class 2: With factory-applied ASJ-SSL jacket.
4. Fabricated shapes in accordance with ASTM C450, ASTM C585, and ASTM C1639.
5. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- G. Flexible Elastomeric: Closed-cell or expanded-rubber materials; suitable for maximum use temperature between minus 70 deg F and 220 deg F. Comply with ASTM C534/C534M, Type I for tubular materials.
- H. Glass-Fiber, Preformed Pipe: Glass fibers bonded with a thermosetting resin; suitable for maximum use temperature up to 850 deg F in accordance with ASTM C411. Comply with ASTM C547.
 1. Preformed Pipe Insulation: Type I, Grade A with factory-applied ASJ-SSL.
 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- I. Mineral Wool, Preformed Pipe: Mandrel-wound mineral wool fibers bonded with a thermosetting resin, unfaced; suitable for maximum use temperature up to 1200 deg F in accordance with ASTM C447. Comply with ASTM C547.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; Micro-Lok.
 - b. Knauf Insulation; 1000-Degree Pipe Insulation.
 - c. Owens Corning; Fiberglas Pipe Insulation.
 2. Preformed Pipe Insulation: Type II, Grade A **with factory-applied ASJ-SSL**.
 3. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
- J. Phenolic: Fabricated pipe insulation of rigid, expanded, closed-cell structure. Comply with ASTM C1126, Type III.
 1. Pre-fabricated Pipe Insulation: Type III with factory-applied ASJ+ jacket.
 2. Fabricated shapes in accordance with ASTM C450 and ASTM C585.
 3. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
- K. Polyolefin: Polyethylene thermal plastic insulation. Comply with ASTM C534/C534M or ASTM C1427, Type I, Grade 1, for tubular materials, self-seal.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armacell LLC; Tubolit.
 - b. Nomaco Insulation; IMCOLOCK and NOMALOCK.

2.3 INSULATING CEMENTS

- A. Glass-Fiber and Mineral Wool Insulating Cement: Comply with ASTM C195.

- B. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C196.
- C. Glass-Fiber and Mineral Wool Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C449.

2.4 ADHESIVES

- A. Materials are compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.
- B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.
- C. Flexible Elastomeric and Polyolefin Adhesive: Solvent-based adhesive.
 - 1. Flame-spread index is 25 or less and smoke-developed index is 50 or less as tested in accordance with ASTM E84.
 - 2. Wet Flash Point: Below 0 deg F.
 - 3. Service Temperature Range: 40 to 200 deg F.
 - 4. Color: Black.
- D. Glass-Fiber and Mineral Wool Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- E. Phenolic Adhesive: Solvent-based resin adhesive, with a service temperature range of minus 75 to plus 300 deg F.
- F. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A, for bonding insulation jacket lap seams and joints.
- G. PVC Jacket Adhesive: Compatible with PVC jacket.

2.5 MASTICS AND COATINGS

- A. Materials are compatible with insulation materials, jackets, and substrates.
- B. Vapor-Retarder Mastic, Water Based: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Comply with MIL-PRF-19565C, Type II, for permeance requirements, with supplier listing on DOD QPD - Qualified Products Database.
 - 4. Color: White.
- C. Vapor-Retarder Mastic, Solvent Based, Indoor Use: Suitable for indoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: 0 to 180 deg F.
 - 3. Color: [White] <Insert color>.

- D. Vapor-Retarder Mastic, Solvent Based, Outdoor Use: Suitable for outdoor use on below-ambient services.
 - 1. Water-Vapor Permeance: Comply with ASTM E96/E96M or ASTM F1249.
 - 2. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 3. Color: [White] <Insert color>.
- E. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.
 - 1. Water-Vapor Permeance: ASTM E96/E96M, greater than 1.0 perm at manufacturer's recommended dry film thickness.
 - 2. Service Temperature Range: 0 to plus 180 deg F.
 - 3. Color: White.

2.6 LAGGING ADHESIVES

- A. Adhesives comply with MIL-A-3316C, Class I, Grade A, and are compatible with insulation materials, jackets, and substrates.
 - 1. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
 - 2. Service Temperature Range: 20 to plus 180 deg F.
 - 3. Color: White.

2.7 SEALANTS

- A. Materials are as recommended by the insulation manufacturer and are compatible with insulation materials, jackets, and substrates.
- B. Joint Sealants:
 - 1. Permanently flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 58 to plus 176 deg F.
 - 3. Color: White or gray.
- C. FSK and Metal Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 3. Color: Aluminum.
- D. ASJ Flashing Sealants and PVC Jacket Flashing Sealants:
 - 1. Fire- and water-resistant, flexible, elastomeric sealant.
 - 2. Service Temperature Range: Minus 40 to plus 250 deg F.
 - 3. Color: White.

2.8 FACTORY-APPLIED JACKETS

- A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C1136, Type I.
 2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C1136, Type I.
 3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C1136, Type II.
 4. ASJ+: Aluminum foil reinforced with glass scrim bonded to a kraft paper interleaving with an outer film leaving no paper exposed; complying with ASTM C1136 Types I, II, III, IV, and VII.
 5. PSK Jacket: Aluminum foil fiberglass reinforced scrim with polyethylene backing, complying with ASTM C1136, Type II.

2.9 FIELD-APPLIED JACKETS

- A. I, unless otherwise indicated.
- B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.
- C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Johns Manville; Zeston Perma-Weld, CEEL-TITE Solvent Welding Adhesive.
 2. Adhesive: As recommended by jacket material manufacturer.
 3. Color: White.
 4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
 - a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.
- D. Metal Jacket:
1. Aluminum Jacket: Comply with ASTM B209, Alloy 3003, 3005, 3105, or 5005, Temper H-14.
 - a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
 - b. Finish and thickness are indicated in field-applied jacket schedules.
 - c. Moisture Barrier for Indoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
 - e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.

- 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
- 3) Tee covers.
- 4) Flange and union covers.
- 5) End caps.
- 6) Beveled collars.
- 7) Valve covers.
- 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

2. Stainless Steel Jacket: ASTM A240/A240M.

- a. Sheet and roll stock ready for shop or field sizing or Factory cut and rolled to size.
- b. Material, finish, and thickness are indicated in field-applied jacket schedules.
- c. Moisture Barrier for Indoor Applications 3-mil-thick, heat-bonded polyethylene and kraft paper.
- d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper.
- e. Factory-Fabricated Fitting Covers:
 - 1) Same material, finish, and thickness as jacket.
 - 2) Preformed two-piece or gore, 45- and 90-degree, short- and long-radius elbows.
 - 3) Tee covers.
 - 4) Flange and union covers.
 - 5) End caps.
 - 6) Beveled collars.
 - 7) Valve covers.
 - 8) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.

E. Underground Direct-Buried Jacket: 125-mil-thick vapor barrier and waterproofing membrane, consisting of a rubberized bituminous resin reinforced with a woven-glass fiber or polyester scrim and laminated aluminum foil.

F. Self-Adhesive Outdoor Jacket (Asphaltic): 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a cross-laminated polyethylene film covered with **white** aluminum-foil facing.

G. Self-Adhesive Indoor/Outdoor Jacket (Non-Asphaltic): Vapor barrier and waterproofing jacket for installation over insulation located aboveground outdoors or indoors. Specialized jacket with five layers of laminated aluminum and polyester film with low-temperature acrylic pressure-sensitive adhesive. Outer aluminum surface is coated with UV-resistant coating for protection from environmental contaminants.

1. Permeance: 0.00 perm as tested in accordance with ASTM F1249.
2. Flamespread/Smoke Developed: 25/50 as tested in accordance with ASTM E84.
3. Aluminum Finish: Smooth.

2.10 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Mesh: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in. for covering pipe and pipe fittings.

- B. Woven Polyester Mesh: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. in, in a Leno weave, for pipe.

2.11 FIELD-APPLIED CLOTHS

- A. Woven Glass-Fiber Cloth: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd.

2.12 TAPES

- A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C1136.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABI, Ideal Tape Division; 428 AWF ASJ.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
 - c. Compac Corporation; 104 and 105.
 - d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
- 2. Width: 3 inches.
- 3. Thickness: 11.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

- B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C1136.

- 1. Width: 3 inches.
- 2. Thickness: 6.5 mils.
- 3. Adhesion: 90 ounces force/inch in width.
- 4. Elongation: 2 percent.
- 5. Tensile Strength: 40 lbf/inch in width.
- 6. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ABI, Ideal Tape Division; 370 White PVC tape.
 - b. Compac Corporation; 130.
 - c. Venture Tape; 1506 CW NS.
- 2. Width: 2 inches.
- 3. Thickness: 6 mils.
- 4. Adhesion: 64 ounces force/inch in width.

5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Width: 2 inches.
2. Thickness: 3.7 mils.
3. Adhesion: 100 ounces force/inch in width.
4. Elongation: 5 percent.
5. Tensile Strength: 34 lbf/inch in width.

2.13 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A240/A240M, Type 304 or Type 316; 0.015-inch thick 3/4 inch wide with closed seal.
2. Aluminum: ASTM B20, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020-inch thick, 3/4 inch wide with closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless-steel, or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

2.14 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing.
2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
 2. Verify that surfaces to be insulated are clean and dry.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range of between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Carbon Steel: Coat carbon steel operating at a service temperature of between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Coordinate insulation installation with the tradesman installing heat tracing. Comply with requirements for heat tracing that apply to insulation.
- D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Install insulation materials, forms, vapor barriers or retarders, jackets, and of thicknesses required for each item of pipe system, as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, compress, or otherwise damage insulation or jacket.
- D. Install insulation with longitudinal seams at top and bottom (12 o'clock and 6 o'clock positions) of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during storage, application, and finishing. Replace insulation materials that get wet during storage or in the installation process before being properly covered and sealed in accordance with Contract Documents, unless otherwise approved by the engineer-of-record.

- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends attached to structure with vapor-barrier mastic.
 - 3. Install insert materials and insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth, but not to the extent of creating wrinkles or areas of compression in the insulation.
 - 2. Cover circumferential joints with 3-inch-wide strips of same material as insulation jacket. Secure strips with adhesive and outward-clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward-clinching staples along edge at 4 inches o.c.
 - a. For below-ambient services, apply vapor-barrier mastic over staples.
 - 4. Cover joints and seams with tape, in accordance with insulation material manufacturer's written instructions, to maintain vapor seal.
 - 5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.
- M. Cut insulation in a manner to avoid compressing insulation.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches in similar fashion to butt joints.
- P. For above-ambient services, do not install insulation to the following:
 - 1. Vibration-control devices.
 - 2. Testing agency labels and stamps.
 - 3. Nameplates and data plates.
 - 4. Cleanouts.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.
- C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.
- F. Insulation Installation at Floor Penetrations:
 - 1. Pipe: Install insulation continuously through floor penetrations.
 - 2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

- A. Requirements in this article generally apply to all insulation materials, except where more specific requirements are specified in various pipe insulation material installation articles below.
- B. Insulation Installation on Fittings, Valves, Strainers, Flanges, Mechanical Couplings, and Unions:
 - 1. Install insulation over fittings, valves, strainers, flanges, mechanical couplings, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
 - 2. Insulate pipe elbows using **preformed** fitting insulation or mitered or routed fittings made from same material and density as that of adjacent pipe insulation. Each piece is butted tightly against

- adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as that used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation of same material, density, and thickness as that used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers, so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
 6. Insulate flanges, mechanical couplings, and unions, using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than 2 times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Stencil or label the outside insulation jacket of each union with the word "union" matching size and color of pipe labels.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket, except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing, using PVC tape.
- C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- D. Install removable insulation covers at locations indicated. Installation conforms to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as that of adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union at least 2 times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
 5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered or routed sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install sections of pipe insulation and miter if required in accordance with manufacturer's written instructions.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated valve covers manufactured of same material as that of pipe insulation when available.
2. When prefabricated valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 INSTALLATION OF GLASS-FIBER AND MINERAL WOOL INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with glass-fiber or mineral-wool blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.

2. When prefabricated insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install prefabricated sections of same material as that of straight segments of pipe insulation when available.
2. When prefabricated sections are not available, install fabricated sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.9 INSTALLATION OF PHENOLIC INSULATION

A. General Installation Requirements:

1. Secure single-layer insulation with stainless steel bands at 12-inch intervals and tighten bands without deforming insulation materials.
2. Install two-layer insulation with joints tightly butted and staggered at least 3 inches. Secure inner layer with 0.062-inch wire spaced at 12-inch intervals. Secure outer layer with stainless steel bands at 12-inch intervals.

B. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with jackets with vapor retarders on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive, as recommended by insulation material manufacturer, and seal with vapor-barrier mastic and flashing sealant.

C. Insulation Installation on Pipe Flanges:

1. Install prefabricated pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of block insulation of same material and thickness as that of pipe insulation. Where voids are difficult to fill with block insulation, fill the voids with a fibrous insulation material suitable for the specific operating temperature.

D. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.

E. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed insulation sections of same material as that of straight segments of pipe insulation. Secure according to manufacturer's written instructions.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.10 INSTALLATION OF POLYOLEFIN INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Seal split-tube longitudinal seams and end joints with manufacturer's recommended adhesive, or via self-seal mechanism to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of polyolefin sheet insulation of same thickness as that of pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of polyolefin pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install cut sections of polyolefin pipe and sheet insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties, and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.11 INSTALLATION OF FIELD-APPLIED JACKETS

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
 2. Install lap or joint strips with same material as jacket.
 3. Secure jacket to insulation with manufacturer's recommended adhesive.
 4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
 5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.
- C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
- D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless steel bands 12 inches o.c. and at end joints.

3.12 FINISHES

- A. Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.
 - a. Finish Coat Material: Interior, flat, latex-emulsion size.
- B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
- C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.
- D. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Owner will engage a qualified testing agency to perform tests and inspections.
- B. Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections: Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of

inspection is limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

- F. All insulation applications will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.14 PIPING INSULATION SCHEDULE, GENERAL

- A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.
- B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
 - 1. Drainage piping located in crawl spaces.
 - 2. Underground piping.
 - 3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

- A. Domestic Hot and Recirculated Hot Water:
 - 1. NPS 1 and Smaller: Insulation is one of the following:
 - a. Cellular Glass: 1 inch thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1 inch thick.
 - 2. NPS 1-1/4 and Larger: Insulation is one of the following:
 - a. Cellular Glass: 1-1/2 inches thick.
 - b. Glass-Fiber, Preformed Pipe Insulation, Type I: 1-1/2 inches thick.
 - c. Mineral Wool, Preformed Pipe Insulation, Type II: 1-1/2 inches thick.
- B. Condensate Piping:
 - 1. All condensate piping within the building shall be insulated with "Imcoa" "Imcolock" 3/4" nominal wall thickness closed-cell insulation. Insulation shall have a flame spread of not more than 25 and a smoke density not exceeding 50 per 2022 CMC. All joints shall be mitered and secured with black duct tape.
- C. Indirect Waste Pipe Insulation: All indirect waste drains from refrigerated kitchen equipment shall be insulated with "Armacell" "Armaflex" insulating tape.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Domestic Hot and Recirculated Hot Water:

1. All Pipe Sizes: Insulation is one of the following:
 - a. Cellular Glass: 2 inches thick.
 - b. Flexible Elastomeric: 2 inches thick.
 - c. Glass-Fiber, Preformed Pipe Insulation, Type I: 2 inches thick.
 - d. Mineral Wool, Preformed Pipe Insulation, Type II: 2 inches thick.
 - e. Phenolic: 2 inches thick.
 - f. Polyolefin: 2 inches thick.

3.17 OUTDOOR, UNDERGROUND PIPING INSULATION SCHEDULE

- A. Sanitary Waste Piping, All Sizes, Where Heat Tracing Is Installed: Cellular glass, 2 inches thick.
- B. Chilled Water, All Sizes: Cellular glass, 2 inches thick.

3.18 INDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
 2. PVC, Color-Coded by System: 30 mils thick.
- D. Piping, Exposed:
 1. None.
 2. PVC, Color-Coded by System: 30 mils thick.
 3. Stainless Steel, Type 316, Smooth No. 2B Finish: 0.020 inch thick

3.19 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- B. If more than one material is listed, selection from materials listed is Contractor's option.
- C. Piping, Concealed:
 1. None.
 2. PVC, Color-Coded by System: 30 mils thick.

- D. Piping, Exposed:
 - 1. Stainless Steel, Type 316, Smooth No. 2B Finish with Z-Shaped Locking Seam: 0.024 inch thick.

3.20 UNDERGROUND, FIELD-APPLIED INSULATION JACKET

- A. For underground direct-buried piping applications, install underground direct-buried jacket over insulation material.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Copper tube and fittings.
2. Piping joining materials.
3. Encasement for piping.
4. Transition fittings.
5. Dielectric fittings.

B. Related Requirements:

1. Section 331415 "Site Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:

1. C.C.R., Title 24, Part 5 (2022 CPC).
2. 2022 California Plumbing Code.
3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
4. National Fire Protection Association.
5. California Division of the State Architect.
6. California State Division of Industrial Safety.
7. County Health Department.
8. Any other legally constituted body-having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.4 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.5 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.6 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.
- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.
- D. Domestic Water: The Contractor shall be responsible for the domestic water service outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite domestic water system.

1.7 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

- A. Product Data:
 - 1. Pipe and tube.
 - 2. Fittings.
 - 3. Joining materials.
 - 4. Transition fittings.

1.11 SUBMITTAL DATA

- A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".

- b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Piping layout, or BIM model, drawn to scale, showing the items described in this Section, and coordinated with all building trades.
- B. System purging and disinfecting activities report.
- C. Field quality-control reports.

1.13 FIELD CONDITIONS

- A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
 1. Notify Architect, Construction Manager and/or Owner no fewer than two days in advance of proposed interruption of water service.
 2. Do not interrupt water service without Architect's, Construction Manager's and/or Owner's written permission.

1.14 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.

- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.16 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.17 WARRANTY

- A. Polypropylene Piping (PP-R) Manufacturer's Warranty: Manufacturer agrees to repair or replace PP-R pipe and fittings that fail in materials or workmanship within 10 years from date of Substantial Completion.
 - 1. Warranty is to cover labor and material costs of repairing and/or replacing defective materials and repairing any incidental damage caused by failure of the piping system due to defects in materials or manufacturing.
 - 2. Warranty is to be in effect only upon submission by the Contractor to the manufacturer of valid pressure/leak documentation indicating that the system was tested and passed the manufacturer's pressure/leak test.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

- A. Potable-water piping, and components shall comply with NSF 14, NSF 61, and NSF 372. Include marking "NSF-pw" on piping.

2.2 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Mueller Streamline Co.
 - 2. Cerro Flow Products
- B. Drawn-Temper Copper Tube: ASTM B88, Type L.
- C. Annealed-Temper Copper Tube: ASTM B88, Type K.
- D. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.
- E. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, pressure fittings.
- F. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
- G. Cast Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces and solder-joint or threaded ends.
- H. Wrought Copper Unions: ASME B16.22.

2.3 PIPING JOINING MATERIALS

- A. Pipe-Flange Gasket Materials:
 - 1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
 - 2. Full-face or ring type unless otherwise indicated.
- B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
- C. Solder Filler Metals: ASTM B32, 95-5 silver lead-free alloys.
- D. Flux: ASTM B813, water flushable.
- E. Brazing Filler Metals: AWS A5.8M/A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing unless otherwise indicated.
- F. Solvent Cements for Joining CPVC Piping and Tubing: ASTM F493.
- G. Solvent Cements for Joining PVC Piping: ASTM D2564. Include primer according to ASTM F656.
- H. Plastic, Pipe-Flange Gaskets, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.4 ENCASEMENT FOR PIPING

- A. Standard: ASTM A674 or AWWA C105/A21.5.
- B. Form: Sheet or tube.

- C. Color: Black or natural.
- D. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

<u>Pipe Size / Type</u>	<u>Polywrap Flat Tube Width</u>
½" to ¾" copper	2"
1" to 1-½" copper	3"
2" copper	4"
2-1/2" copper	5"
3" copper	6"

2.5 TRANSITION FITTINGS

- A. General Requirements:
 - 1. Same size as pipes to be joined.
 - 2. Pressure rating at least equal to pipes to be joined.
 - 3. End connections compatible with pipes to be joined.
- B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
- C. Sleeve-Type Transition Coupling: AWWA C219.
- D. Plastic-to-Metal Transition Fittings:
 - 1. Description:
 - a. CPVC or PVC one-piece fitting with manufacturer's Schedule 80 equivalent dimensions.
 - b. One end with threaded brass insert and one solvent-cement-socket or threaded end.
- E. Plastic-to-Metal Transition Unions:
 - 1. Description:
 - a. CPVC or PVC four-part union.
 - b. Brass **or stainless-steel** threaded end.
 - c. Solvent-cement-joint **or threaded** plastic end.
 - d. Rubber O-ring.
 - e. Union nut.

2.6 DIELECTRIC FITTINGS

- A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
- B. Dielectric Unions:
 - 1. Standard: ASSE 1079.
 - 2. Pressure Rating: 125 psig minimum at 180 deg F.
 - 3. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

1. Standard: ASSE 1079.
2. Factory-fabricated, bolted, companion-flange assembly.
3. Pressure Rating: 150 psig.
4. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

1. Nonconducting materials for field assembly of companion flanges.
2. Pressure Rating: 150 psig.
3. Gasket: Neoprene or phenolic.
4. Bolt Sleeves: Phenolic or polyethylene.
5. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

1. Standard: IAPMO PS 66.
2. Electroplated steel nipple complying with ASTM F1545.
3. Pressure Rating and Temperature: 300 psig at 225 deg F.
4. End Connections: Male threaded or grooved.
5. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
- B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.
- C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.
- D. Under-building-slab, domestic water, building-service piping, NPS 3 and smaller, shall be the following:
 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- E. Under-building-slab, domestic water, building-service piping, NPS 4 to NPS 8 and larger, shall be one of the following:
 1. Annealed-temper copper tube, ASTM B88, Type K; wrought-copper, solder-joint fittings; and brazed joints.
- F. Under-building-slab, domestic water piping, NPS 2, shall be the following:
 1. Drawn-temper or annealed-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and brazed joints.

G. Aboveground domestic water piping, NPS 2, shall be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

H. Aboveground domestic water piping, NPS 2-1/2 to NPS 4, shall be the following:

1. Drawn-temper copper tube, ASTM B88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.2 EARTHWORK

A. Comply with requirements in Section 312000 "Earth Moving" for excavating, trenching, and backfilling.

3.3 INSTALLATION OF PIPING

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."
- C. Install ductile-iron piping under building slab with restrained joints according to AWWA C600 and AWWA M41.
- D. Install underground copper tube in PE encasement according to ASTM A674 or AWWA C105/A21.5.
- E. Install valves according to the following:
1. Section 220523 "General-Duty Valves for Plumbing Piping."
- F. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements for pressure-reducing valves in Section 221119 "Domestic Water Piping Specialties."
- G. Install domestic water piping level without pitch and plumb.
- H. Rough-in domestic water piping for water-meter installation according to utility company's requirements.
- I. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- J. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.
- K. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- L. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

- M. Install piping to permit valve servicing.
- N. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.
- O. Install piping free of sags and bends.
- P. Install fittings for changes in direction and branch connections.
- Q. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.
- R. Install pressure gauges on suction and discharge piping for each plumbing pump and packaged booster pump. Comply with requirements for pressure gauges in Section 220519 "Meters and Gages for Plumbing Piping."
- S. Install thermostats in hot-water circulation piping. Comply with requirements for thermostats in Section 221123 "Domestic Water Pumps."
- T. Install thermometers on outlet piping from each water heater. Comply with requirements for thermometers in Section 220519 "Meters and Gages for Plumbing Piping."
- U. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- W. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.4 JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads.
 - 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
- D. Brazed Joints for Copper Tubing: Comply with CDA's "Copper Tube Handbook," "Braze Joints" chapter.
- E. Soldered Joints for Copper Tubing: Apply ASTM B813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B828 or CDA's "Copper Tube Handbook."
- F. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools and procedure recommended by pressure-seal-fitting manufacturer. Leave insertion marks on pipe after assembly.

- G. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.
- H. Extruded-Tee Connections: Form tee in copper tube according to ASTM F2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.
- I. Joint Construction for Grooved-End Copper Tubing: Make joints according to AWWA C606. Roll groove ends of tubes. Lubricate and install gasket over ends of tubes or tube and fitting. Install coupling housing sections over gasket with keys seated in tubing grooves. Install and tighten housing bolts.
- J. Joint Construction for Grooved-End, Ductile-Iron Piping: Make joints according to AWWA C606. Cut round-bottom grooves in ends of pipe at gasket-seat dimension required for specified (flexible or rigid) joint. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- K. Joint Construction for Grooved-End Steel Piping: Make joints according to AWWA C606. Square cut or Roll groove ends of pipe as specified. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket with keys seated in piping grooves. Install and tighten housing bolts.
- L. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.
- M. Joint Construction for Solvent-Cemented Plastic Piping: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements. Apply primer.
 - 2. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
 - 3. PVC Piping: Join according to ASTM D2855.
- N. Joints for PEX Tubing, ASTM: Join according to ASTM F1807 for metal insert and copper crimp ring fittings and ASTM F1960 for cold expansion fittings and reinforcing rings.
- O. Joints for PEX Tubing, ASSE: Join according to ASSE 1061 for push-fit fittings.
- P. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.5 INSTALLATION OF TRANSITION FITTINGS

- A. Install transition couplings at joints of dissimilar piping.
- B. Transition Fittings in Underground Domestic Water Piping:
 - 1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
 - 2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

3.6 INSTALLATION OF DIELECTRIC FITTINGS

- A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
- B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.
- C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges.
- D. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.7 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
- C. Install hangers for copper tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping within 12 inches of each fitting.
- E. Support vertical runs of **copper tubing and piping** to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.8 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.
- C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.
- D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:
 - 1. Domestic Water Booster Pumps: Cold-water suction and discharge piping.
 - 2. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
 - 3. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
 - 4. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

3.10 ADJUSTING

- A. Perform the following adjustments before operation:
 - 1. Close drain valves, hydrants, and hose bibbs.
 - 2. Open shutoff valves to fully open position.
 - 3. Open throttling valves to proper setting.
 - 4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
 - a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
 - b. Adjust calibrated balancing valves to flows indicated.
 - 5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
 - 6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
 - 7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
 - 8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.11 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Piping Inspections:
 - a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
 - b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
 - 1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
 - 2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.
 - c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections, and arrange for reinspection.
 - d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
 - 2. Piping Tests:
 - a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.

- b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
 - c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
 - d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 - e. Hydrostatic testing and documentation of test results for polypropylene piping to be in accordance with the manufacturer's instructions and submitted to the manufacturer upon successful completion per warranty requirements.
 - f. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
 - g. Prepare reports for tests and for corrective action required.
- B. Domestic water piping will be considered defective if it does not pass tests and inspections.
- C. Prepare test and inspection reports.

3.12 CLEANING

- A. Clean and disinfect potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
 - b. Fill and isolate system according to either of the following:
 - 1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
 - 2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
 - c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
 - d. Repeat procedures if biological examination shows contamination.
 - e. Submit water samples in sterile bottles to authorities having jurisdiction.
- B. Clean non-potable domestic water piping as follows:
- 1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
 - 2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:
 - a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

- b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.
- C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.
- D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

END OF SECTION 221116

SECTION 221119 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vacuum breakers.
2. Backflow preventers.
3. Water pressure-reducing valves.
4. Balancing valves.
5. Temperature-actuated, water mixing valves.
6. Strainers for domestic water piping.
7. Hose bibbs.
8. Drain valves.
9. Water-hammer arresters.
10. Trap-seal primer device.
11. Trap-seal primer systems.
12. Flexible connectors.

B. Related Requirements:

1. Section 220519 "Meters and Gauges for Plumbing Piping" for thermometers, pressure gauges, and flow meters in domestic water piping.
2. Section 221116 "Domestic Water Piping" for water meters.
3. Section 331415 "Site Water Distribution Piping" for fire water-service backflow prevention devices.

1.2 DEFINITIONS

- A. AMI: Advanced Metering Infrastructure.
- B. AMR: Automatic Meter Reading.
- C. FKM: A family of fluoroelastomer materials defined by ASTM D1418.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.7 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.8 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For domestic water piping specialties.
 - 1. Include diagrams for power, signal, and control wiring.

1.9 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any,

and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.

- b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
- c. Include all pertinent construction, installation, performance, and technical data.
- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

- 1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
- 2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
- 3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
- 4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which

indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.10 INFORMATIONAL SUBMITTALS

- A. Test and inspection reports.
- B. Field quality-control reports.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.12 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.13 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.14 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

- A. Domestic water piping specialties intended to convey or dispense water for human consumption are to comply with the SDWA, requirements of authorities having jurisdiction, and NSF 61 and NSF 372, or to be certified in compliance with NSF 61 and NSF 372 by an American National Standards Institute (ANSI)-accredited third-party certification body that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

2.2 PERFORMANCE REQUIREMENTS

- A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig unless otherwise indicated.

2.3 VACUUM BREAKERS

- A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1001.
 - 3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
 - 4. Body: Bronze.
 - 5. Inlet and Outlet Connections: Threaded.
 - 6. Finish: Rough bronze.
- B. Hose-Connection Vacuum Breakers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - c. Zurn Industries, LLC; Plumbing Products Group; Light Commercial Products.
 - d. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
 - 2. Standard: ASSE 1011.

3. Body: Bronze, nonremovable, with manual drain.
4. Outlet Connection: Garden-hose threaded complying with ASME B1.20.7.
5. Finish: Rough bronze.

C. Pressure Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
 - b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1020.
3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle third of flow range.
5. Size: See plumbing drawings.
6. Design Flow Rate: See plumbing drawings.
7. Selected Unit Flow Range Limits: See plumbing drawings.
8. Pressure Loss at Design Flow Rate: See plumbing drawings.
9. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

D. Laboratory-Faucet Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1035.
3. Size: NPS 1/4 or NPS 3/8 matching faucet size.
4. Body: Bronze.
5. End Connections: Threaded.
6. Finish: Chrome plated.

E. Spill-Resistant Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1056.
3. Operation: Continuous-pressure applications.
4. Size: See plumbing drawings.
5. Accessories:
 - a. Valves: Ball type, on inlet and outlet.

2.4 BACKFLOW PREVENTERS

A. Intermediate Atmospheric-Vent Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1012.
3. Operation: Continuous-pressure applications.
4. Size: See plumbing drawings.
5. Body: Bronze.
6. End Connections: Union, solder joint.
7. Finish: Rough bronze.

B. Backflow-Preventer Test Kits:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Description: Factory calibrated, with gauges, fittings, hoses, and carrying case with test-procedure instructions.

2.5 WATER PRESSURE-REDUCING VALVES

A. Water Regulators:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 150 psig.
4. Size: See plumbing drawings.
5. Design Flow Rate: See plumbing drawings.
6. Design Inlet Pressure: See plumbing drawings.
7. Design Outlet Pressure Setting: See plumbing drawings.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and NPS 3.
9. Valves for Booster Heater Water Supply: Include integral bypass.
10. End Connections: Threaded or solder for NPS 2 and smaller; flanged or solder for NPS 2-1/2 and NPS 3.

B. Water-Control Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.

- b. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
- 2. Description: Pilot-operated, diaphragm-type, single-seated, main water-control valve.
- 3. Pressure Rating: Initial working pressure of 150 psig minimum with AWWA C550 or FDA-approved, interior epoxy coating. Include small pilot-control valve, restrictor device, specialty fittings, and sensor piping.
- 4. Main Valve Body: Cast- or ductile-iron body with AWWA C550 or FDA-approved, interior epoxy coating; or stainless-steel body.
 - a. Size: See plumbing drawings.
 - b. Pattern: Angle-valve design.
 - c. Trim: Stainless-steel.
- 5. Design Flow: See plumbing drawings.
- 6. Design Inlet Pressure: See plumbing drawings.
- 7. Design Outlet Pressure Setting: See plumbing drawings.
- 8. End Connections: Threaded for NPS 2 and smaller; **flanged** for NPS 2-1/2 and larger.

2.6 BALANCING VALVES

A. Copper-Alloy Calibrated Balancing Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong International, Inc.
 - b. NIBCO Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
 - d. Bell & Gossett, Circuit Setter Plus
- 2. Type: Ball or Y-pattern globe valve with two readout ports and memory-setting indicator.
- 3. Body: Brass or bronze.
- 4. Size: Same as connected piping, but not larger than NPS 2.
- 5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves:

- 1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Armstrong International, Inc.
 - b. NIBCO Inc.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
- 2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
- 3. Pressure Rating: 400-psig minimum CWP.
- 4. Size: NPS 2 or smaller.
- 5. Body: Copper alloy.
- 6. Port: Standard or full port.
- 7. Ball: Chrome-plated brass or stainless steel.
- 8. Seats and Seals: Replaceable.
- 9. End Connections: Solder joint or threaded.
- 10. Handle: Vinyl-covered steel with memory-setting device.

C. Automatic Flow Control Balancing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Symmons Industries, Inc.
 - b. Bradley.
2. Flow Regulation: Plus, or minus 5 percent over 95 percent of the working range.
3. Pressure Rating: 200 psig.
4. Size: NPS 2 or smaller.
5. Body: Stainless steel or brass.
6. Flow Cartridge: Stainless-steel or antiscaling polymer.
7. End Connections: Threaded or solder joint.

2.7 TEMPERATURE-ACTUATED, WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - a. Symmons Industries, Inc.
 - b. Bradley Corp.
 - c. Leonard Valve Company.
 - d. Powers Controls; a division of Watts Water Technologies
2. Standard: ASSE 1016, thermostatically controlled, water tempering valve.
3. Pressure Rating: 125 psig minimum unless otherwise indicated.
4. Material: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Connections: Threaded inlets and outlet.
7. Finish: Chrome plated.
8. Tempered-Water Setting: See plumbing drawings.
9. Tempered-Water Design Flow Rate: See plumbing drawings.

2.8 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig minimum unless otherwise indicated.
2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved, epoxy coated and for NPS 2-1/2 and larger.
3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
4. Screen: Stainless steel with round perforations unless otherwise indicated.
5. Perforation Size:
 - a. Strainers NPS 2 and Smaller: 0.020 inch.
 - b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.
 - c. Strainers NPS 5 and Larger: 0.10 inch.
6. Drain: Factory-installed, hose-end drain valve.

2.9 HOSE BIBBS

A. Hose Bibbs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Acorn Engineering Company.
 - b. Woodford Manufacturing Company; a division of WCM Industries, Inc.
 - c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company
2. Standard: ASME A112.18.1 for sediment faucets.
3. Body Material: Bronze.
4. Seat: Bronze, replaceable.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
6. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
7. Pressure Rating: 125 psig.
8. Vacuum Breaker: Integral, nonremovable, drainable, hose-connection vacuum breaker complying with ASSE 1011.
9. Finish for Equipment Rooms: Rough bronze, or chrome or nickel plated.
10. Finish for Service Areas: Chrome or nickel plated.
11. Finish for Finished Rooms: Chrome or nickel plated.
12. Operation for Equipment Rooms: Wheel handle or operating key.
13. Operation for Service Areas: Operating key.
14. Operation for Finished Rooms: Operating key.
15. Include operating key with each operating-key hose bibb.
16. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.10 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.
4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

B. Gate-Valve-Type, Hose-End Drain Valves:

1. Standard: MSS SP-80 for gate valves.
2. Pressure Rating: Class 125.
3. Size: NPS 3/4.
4. Body: ASTM B62 bronze.
5. Inlet: NPS 3/4 threaded or solder joint.
6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

C. Stop-and-Waste Drain Valves:

1. Standard: MSS SP-110 for ball valves or MSS SP-80 for gate valves.
2. Pressure Rating: 200-psig minimum CWP or Class 125.
3. Size: NPS 3/4.
4. Body: Copper alloy or ASTM B62 bronze.
5. Drain: NPS 1/8 side outlet with cap.

2.11 WATER-HAMMER ARRESTERS

A. Water-Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Precision Plumbing Products, Inc.
 - b. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - c. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company
2. Standard: ASSE 1010 or PDI-WH 201.
3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F, or PDI-WH 201, Sizes A through F.

2.12 TRAP-SEAL PRIMER DEVICE

A. Supply-Type, Trap-Seal Primer Device:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
 - c. Zurn Industries, LLC; Plumbing Products Group; Specification Drainage Products.
 - d. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company
2. Standard: ASSE 1018.
3. Pressure Rating: 125 psig minimum.
4. Body: Bronze.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

2.13 TRAP-SEAL PRIMER SYSTEMS

A. Trap-Seal Primer Systems:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. MIFAB, Inc.
 - b. Precision Plumbing Products, Inc.
2. Standard: ASSE 1044.
 3. Inlet Size: NPS 3/4, ASTM B88, Type L; copper, water tubing.
 4. Cabinet: Recessed-mounted steel box with stainless steel cover.
 5. Electric Controls: 24-hour timer, solenoid valve, and manual switch for 120 V ac power.
 - a. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 6. Vacuum Breaker: ASSE 1001.
 7. Number Outlets: See plumbing drawings.
 8. Size Outlets: NPS 1/2.

2.14 FLEXIBLE CONNECTORS

- A. Bronze-Hose Flexible Connectors: Corrugated-bronze tubing with bronze wire-braid covering and ends brazed to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded copper pipe or plain-end copper tube.
 3. End Connections NPS 2-1/2 and Larger: Flanged copper alloy.
- B. Stainless Steel-Hose Flexible Connectors: Corrugated-stainless steel tubing with stainless steel wire-braid covering and ends welded to inner tubing.
 1. Working-Pressure Rating: Minimum 200 psig.
 2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
 3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING SPECIALTIES

- A. Backflow Preventers: Install in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
 1. Locate backflow preventers in same room as connected equipment or system.
 2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe-to-floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are unacceptable for this application.
 3. Do not install bypass piping around backflow preventers.
- B. Water Regulators: Install with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gauges on inlet and outlet.

- C. Water Control Valves: Install with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gauges on inlet and outlet.
- D. Balancing Valves: Install in locations where they can easily be adjusted. Set at indicated design flow rates.
- E. Temperature-Actuated, Water Mixing Valves: Install with check stops or shutoff valves on inlets and with shutoff valve on outlet.
 - 1. Install cabinet-type units recessed in or surface mounted on wall as specified.
- F. Y-Pattern Strainers: For water, install on supply side of each control valve, water pressure-reducing valve, solenoid valve, and pump.
- G. Water-Hammer Arresters: Install in water piping in accordance with PDI-WH 201.
- H. Supply-Type, Trap-Seal Primer Device: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.
- I. Drainage-Type, Trap-Seal Primer Device: Install as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.
- J. Trap-Seal Primer Systems: Install with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 PIPING CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. When installing piping specialties adjacent to equipment and machines, allow space for service and maintenance.

3.3 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.

3.4 CONTROL CONNECTIONS

- A. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 IDENTIFICATION

- A. Plastic Labels for Equipment: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
 - 1. Vacuum breakers.
 - 2. Backflow preventers.
 - 3. Water pressure-reducing valves.
 - 4. Balancing valves.
 - 5. Temperature-actuated, water mixing valves.
 - 6. Trap-seal primer device.
 - 7. Trap-seal primer systems.
- B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.6 ADJUSTING

- A. Set field-adjustable pressure set points of water pressure-reducing valves.
- B. Set field-adjustable flow set points of balancing valves.
- C. Set field-adjustable temperature set points of temperature-actuated, water mixing valves.
- D. Adjust each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer in accordance with manufacturer's written instructions, authorities having jurisdiction and the device's reference standard.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections **with the assistance of a factory-authorized service representative**.
 - 1. Test each pressure vacuum breaker, reduced-pressure-principle backflow preventer, double-check, backflow-prevention assembly, and double-check, detector-assembly backflow preventer according to authorities having jurisdiction and the device's reference standard.
 - 2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start units to confirm unit operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

- D. Domestic water piping specialties will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION 221119

SECTION 221123 - DOMESTIC-WATER PUMPS

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. In-line, sealless centrifugal pumps.

1.3 DEFINITIONS

- A. PID: Proportional Integral Derivative.
- B. VFC: Variable-frequency controller.

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, and dimensions of individual components and profiles.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
- B. Shop Drawings: For booster pumps.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Delegated-Design Submittal: For domestic-water packaged booster pumps.
 - 1. Include design calculations for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

1.11 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and

Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Detail pumps and adjacent equipment. Show support locations, type of support, weight on each support, required clearances, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Structural members to which pumps will be attached.
 2. Size and location of initial access modules for acoustical tile.
- B. Seismic Qualification Data: Certificates, for booster pumps, accessories, and components, from manufacturer.
 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Field quality-control reports.

1.13 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For booster pumps to include in emergency, operation, and maintenance manuals.

1.14 DELIVERY, STORAGE, AND HANDLING

- A. Retain protective coatings and flange's protective covers during storage.

1.15 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.16 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.17 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.18 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. UL Compliance: UL 778 for motor-operated water pumps.

- C. Drinking Water System Components - Health Effects and Drinking Water System Components - Lead Content Compliance: NSF 61 and NSF 372.
- D. Seismic Performance: Booster pumps shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the booster pump will remain in place without separation of any parts from the booster pump when subjected to the seismic forces specified **and the** booster pump will be fully operational after the seismic event."

2.2 IN-LINE, SEALLESS CENTRIFUGAL PUMPS

- A. Description: Factory-assembled and -tested, in-line, close-coupled, canned-motor, sealless, overhung-impeller centrifugal pumps.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong Pumps Inc.
 - b. Bell & Gossett Domestic Pump; ITT Corporation.
 - c. Grundfos Pumps Corp.
 - d. TACO Incorporated.
 - e. WILO USA LLC - WILO Canada Inc.
 - f. Capacities and Characteristics:
 - 2. Capacity: See Plumbing Circ Pump Schedule.
 - 3. Total Dynamic Head: See Plumbing Circ Pump Schedule.
 - 4. Inlet and Outlet Size: See plumbing drawings.
 - 5. Pump Speed: See Plumbing Circ Pump Schedule.
 - 6. Pump Control: Thermostat & Timer.
 - 7. Motor Horsepower: See Plumbing Circ Pump Schedule.
 - 8. Electrical Characteristics:
 - a. Volts: **120 V**.
 - b. Phase: Single phase.
 - c. Hertz: 60 Hz.
- B. Pump Construction:
 - 1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge type with motor and impeller on common shaft and designed for installation with pump and motor shaft horizontal.
 - 2. Minimum Working Pressure: 125 psig.
 - 3. Maximum Continuous Operating Temperature: 220 deg F.
 - 4. Casing: Bronze, with threaded or companion-flange connections.
 - 5. Impeller: stainless-steel.
 - 6. Motor: See Plumbing Circ Pump Schedule.

2.3 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors.

1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in NFPA 70.

2.4 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Type: Water-immersion temperature sensor, for installation in piping.
2. Range: 50 to 125 deg F.
3. Enclosure: NEMA 250, Type 4X.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
6. Power Requirement: 120 V.
7. Settings: Start pump at 110 deg F and stop pump at 120 deg F.

B. Timers: Electric, for control of hot-water circulation pump.

1. Type: Programmable, seven-day clock with manual override on-off switch.
2. Enclosure: NEMA 250, Type 1, suitable for wall mounting.
3. Operation of Pump: On or off.
4. Transformer: Provide if required.
5. Power Requirement: 120 V.
6. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

2.5 SOURCE QUALITY CONTROL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. ASME Compliance: Comply with ASME B31.9 for piping.

C. UL Compliance for Packaged Pumping Systems:

1. UL 508, "Industrial Control Equipment."
2. UL 508A, "Industrial Control Panels."
3. UL 778, "Motor-Operated Water Pumps."
4. UL 1995, "Heating and Cooling Equipment."

D. Booster pumps shall be listed and labeled as packaged pumping systems by testing agency acceptable to authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for booster pumps and domestic-water-piping system to verify actual locations of piping connections before booster-pump installation.

3.2 INSTALLATION

- A. Booster-Pump Mounting:

- 1. Install booster pumps on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Comply with requirements for vibration isolation and seismic-control devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
 - 3. Comply with requirements for vibration isolation devices specified in Section 220548.13 "Vibration Controls for Plumbing Piping and Equipment."

- B. Support connected domestic-water piping so weight of piping is not supported by booster pumps.

- C. Pump Mounting:

- 1. Install vertically mounted, in-line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using vibration isolation type and deflection as specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.3 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

- B. Booster-Pump Piping Connections: Connect domestic-water piping to booster pumps. Install suction and discharge pipe equal to or greater than size of system suction and discharge headers & piping.

- 1. Install shutoff valves on piping connections to booster-pump suction and discharge headers & piping. Install ball, butterfly, or gate valves same size as suction and discharge headers & piping. Comply with requirements for general-duty valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 2. Install union, flanged, or grooved-joint connections on suction and discharge headers & piping at connection to domestic-water piping. Comply with requirements for unions and flanges specified in Section 221116 "Domestic Water Piping."

3. Install valved bypass, same size as and between piping, at connections to booster-pump suction and discharge headers & piping. Comply with requirements for domestic-water piping specified in Section 221116 "Domestic Water Piping."
4. Install flexible connectors, same size as piping, on piping connections to booster-pump suction and discharge headers & piping. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
5. Where installing piping adjacent to booster pumps, allow space for service and maintenance.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, according to NFPA 70 and NECA 1.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
- C. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.6 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."
- B. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. Perform visual and mechanical inspection.
 - 2. Leak Test: After installation, charge booster pump and test for leaks. Repair leaks and retest until no leaks exist.
 - 3. Operational Test: After electrical circuitry has been energized, start booster pumps to confirm proper motor rotation and booster-pump operation.
 - 4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- E. Pumps and controls will be considered defective if they do not pass tests and inspections.
- F. Inline, domestic-water pump will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

3.8 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service.
 - 1. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

- A. Adjust booster pumps to function smoothly and lubricate as recommended by manufacturer.
- B. Adjust pressure set points.
- C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting booster pump to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.10 DEMONSTRATION

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

END OF SECTION 221123.13

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Hubless, cast-iron soil pipe and fittings.
 2. Copper tube and fittings.
 3. Specialty pipe fittings.
 4. Encasement for underground metal piping.

1.2 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.3 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
1. C.C.R., Title 24, Part 5 (2022 CPC).
 2. 2022 California Plumbing Code.
 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 4. National Fire Protection Association.
 5. California Division of the State Architect.
 6. California State Division of Industrial Safety.
 7. County Health Department.
 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.4 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
1. Soil, Waste, and Vent Piping: 10-foot head of water.

- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.
- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.

- D. Sanitary Sewer: The Contractor shall be responsible for the soil and waste piping outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite sewer system.

1.8 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.9 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For hubless, single-stack drainage system. Include plans, elevations, sections, and details.

1.12 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT

SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".

- b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems

fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.16 FIELD CONDITIONS

- A. Interruption of Existing Sanitary Waste 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 Architect, Construction Manager, and/or Owner 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 Architect's, Construction Manager's, and/or Owner's written permission.

1.17 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation are capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10 ft. head of water.
 - 2. Waste, Force-Main Piping: 150 psig.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation to withstand the effects of earthquake motions determined in accordance with ASCE/SEI 7. See Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment":
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.

2.2 PIPING MATERIALS

- A. Piping materials to bear label, stamp, or other markings of specified testing agency.

- B. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Charlotte Pipe.
 - 2. Tyler Pipe.
 - 3. AB&I Foundry.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark.
 - a. Soil and waste piping within the building itself and outside within five feet (5') of the foundation, shall be no-hub cast iron pipe and fittings, asphaltum coated, free from defects, and shall comply with CISPI. Standard 301, ASTM A-888 or ASTM A-74. Pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute
 - 2. ASTM A888 or CISPI 301.
- C. Single-Stack Aerator Fittings: ASME B16.45, hubless, cast-iron aerator and deaerator drainage fittings.
- D. CISPI, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Anaco.
 - 2. Standards: ASTM C1277 and ASTM C310.
 - 3. Description: Stainless steel shield with stainless steel bands and tightening devices; and ASTM C564, neoprene sleeve with integral, center pipe stop.
- E. Super-Duty, Hubless-Piping Couplings:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky SD 4000 series.
 - 2. Standards: ASTM C1540.
 - 3. Description: Stainless steel corrugated shield with stainless steel bands and tightening devices; and ASTM C564, neoprene sleeve with integral, center pipe stop.
- F. Except where otherwise indicated on the plans, building sewer piping from five feet (5') outside of the building to connections at the sewer shall be PVC (polyvinyl chloride) ASTM D3034, SDR-35 sewer pipe with locked-in gasket (ASTM F477, Elastomeric Seal)
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Heavy-Duty PVCX CI Husky SD 4200.

2.4 COPPER TUBE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Mueller Streamline Co.
 2. Cerro Flow Products
- B. Copper Type DWV Tube: ASTM B306, drainage tube, drawn temper.
- C. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.
- D. Hard Copper Tube: ASTM B88, Type L and Type M, water tube, drawn temper.
- E. Soft Copper Tube: ASTM B88, Type L, water tube, annealed temper.
- F. Solder: ASTM B32, lead free with ASTM B813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

- A. Transition Couplings:
 1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections of same size as and compatible with pipes to be joined.
 2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
 3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C1173.
 - b. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
 - d. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C564, rubber.
 - 2) For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926 PVC.
 - 3) For Dissimilar Pipes: ASTM D5926 PVC or other material compatible with pipe materials being joined.
 4. Shielded, Nonpressure Transition Couplings:
 - a. Heavy-Duty PVCX CI Husky SD 4200
 - b. Standard: ASTM C1460.
 - c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - d. End Connections: Same size as and compatible with pipes to be joined.
 5. Pressure Transition Couplings:

- a. Standard: AWWA C219.
 - b. Description: Metal sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.
 - c. Center-Sleeve Material: Manufacturer's standard.
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.
- B. Dielectric Fittings:
 1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
 2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 125 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
 3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 125 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
 4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel backing washers.
 5. Dielectric Nipples:
 - a. Description:
 - 1) Standard: IAPMO PS 66.
 - 2) Electroplated steel nipple.
 - 3) Pressure Rating: 300 psig at 225 deg F.
 - 4) End Connections: Male threaded or grooved.
 - 5) Lining: Inert and noncorrosive, propylene.

2.6 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Scotchwrap No. 50
 2. Polyken No. 900
 3. Tapecoat CT
 4. Johns-Manville No. V-10
- B. Standard: ASTM A674 or AWWA C105/A 21.5.
- C. Material: Linear low-density polyethylene film of 0.008-inch or high-density, cross-laminated polyethylene film of 0.004-inch minimum thickness.
- D. Form: Sheet or tube.
- E. Color: Black or natural.
- F. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:
- | <u>Pipe Size / Type</u> | <u>Polywrap Flat Tube Width</u> |
|-------------------------|---------------------------------|
| ½" to ¾" copper | 2" |
| 1" to 1-½" copper | 3" |
| 2" copper | 4" |
| 2-1/2" copper | 5" |
| 3" copper | 6" |
| 2" to 3" cast iron | 14" |
| 4" cast iron | 16" |
| 6" cast iron | 20" |
| 8" cast iron | 24" |
- G. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless-steel bolts.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations to layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment".
- K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends.
 - 1. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical.
 - 2. Use long-turn, double Y-branch, and 1/8-bend fittings if two fixtures are installed back-to-back or side by side with common drainpipe.
 - a. Straight tees, elbows, and crosses may be used on vent lines.
 - 3. Do not change direction of flow more than 90 degrees.
 - 4. Use proper size of standard increasers and reducers if pipes of different sizes are connected.
 - a. Reducing size of waste piping in direction of flow is prohibited.
- L. Lay buried building waste piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install soil and waste and vent piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Sanitary Waste: Two percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Sanitary Waste Piping: Two percent downward in direction of flow.
 - 3. Vent Piping: One percent down toward vertical fixture vent or toward vent stack.
- N. Install cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping in accordance with ASTM A674 or AWWA C105/A 21.5.

- O. Install aboveground copper tubing in accordance with CDA's "Copper Tube Handbook."
- P. Install engineered soil and waste and vent piping systems as follows:
 - 1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction.
 - 2. Hubless, Single-Stack Drainage System: Comply with ASME B16.45 and hubless, single-stack aerator fitting manufacturer's written installation instructions.
 - 3. Reduced-Size Venting: Comply with standards of authorities having jurisdiction.
- Q. Install underground, ductile-iron, force-main piping according to AWWA C600.
 - 1. Install buried piping inside building between wall and floor penetrations and connection to sanitary sewer piping outside building with restrained joints.
 - 2. Anchor pipe to wall or floor. Install thrust-block supports at vertical and horizontal offsets.
 - 3. Install encasement on piping in accordance with ASTM A674 or AWWA C105/A 21.5.
- R. Plumbing Specialties:
 - 1. Install backwater valves in sanitary waster gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary waste gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
 - 3. Install drains in sanitary waste gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
- S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- T. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- V. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

W. Encasement:

1. The polyethylene tubing shall be cut into lengths approximately 2 feet longer than the pipe sections. Slip the tube around the pipe, centering it to provide a 1-ft overlap on each adjacent pipe section, and bunching it accordion fashion lengthwise until it clears the pipe ends. Lower the pipe into the trench and make up the pipe joint with the preceding section of pipe. A shallow bell hole must be made at each joint to facilitate installation of the polywrap. The bunched-up polywrap shall be pulled from the preceding length of pipe, slipped over the end of the new length of pipe, and secured in place with one circumferential turn of tape plus enough overlap to assure firm adhesion. The end of the polywrap shall be slipped from the new pipe section over the end of the first wrap until it overlaps the joint at the end of the preceding length of pipe and tape it in place. The loose wrapping on the barrel of the pipe shall be pulled snugly around the barrel of the pipe and excess material folded over the top of the pipe and the folds held in place by means of short strips of adhesive tape, at about 3-foot intervals along the pipe.
2. Rips, punctures, or other damage to the tube shall be repaired with the adhesive tape or pieces of tube material secured with tape. Bends and reducers in the line shall be covered with polyethylene in the same manner as pipe.
3. Valves, tees, crosses, and outlets shall be wrapped with flat sheets of the same material. The sheets shall be passed under valves and brought up around the body to the stem. Edges shall be brought together, folded twice, and secured with the adhesive tape.

3.3 JOINT CONSTRUCTION

- A. Hub-and-Spigot, Cast-Iron Soil Piping Gasketed Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
- B. Hub-and-Spigot, Cast-Iron Soil Piping Caulked Joints: Join in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum caulked joints.
- C. Hubless, Cast-Iron Soil Piping Coupled Joints:
 1. Join hubless, cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- D. Threaded Joints: Thread pipe with tapered pipe threads in accordance with ASME B1.20.1.
 1. Cut threads full and clean using sharp dies.
 2. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - a. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 - b. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.
 - c. Do not use pipe sections that have cracked or open welds.
- E. Join copper tube and fittings with soldered joints in accordance with ASTM B828. Use ASTM B813, water-flushable, lead-free flux and ASTM B32, lead-free-alloy solder.
- F. Grooved Joints: Cut groove ends of pipe in accordance with AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fitting. Install coupling housing sections over gasket, with keys seated in piping grooves. Install and tighten housing bolts.

- G. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in ODs.
2. In Waste Drainage Piping: [**Unshielded**] [**Shielded**], nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

A. General valve installation requirements for general-duty valve installation are specified in the following Sections:

1. Section 220523.12 " General-Duty Valves for Plumbing Piping."

Shutoff Valves:

2. Install shutoff valve on each sewage pump discharge.
3. Install gate or full-port ball valve for piping NPS 2 and smaller.
4. Install gate valve for piping NPS 2-1/2 and larger.

B. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.

C. Backwater Valves: Install backwater valves in piping subject to backflow.

1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
2. Floor Drains: Drain outlet backwater valves unless drain has integral backwater valve.
3. Install backwater valves in accessible locations.
4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment".
 - 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 - 2. Install stainless steel pipe hangers for horizontal piping in corrosive environments.
 - 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 - 4. Install stainless steel pipe support clamps for vertical piping in corrosive environments.
 - 5. Vertical Piping: MSS Type 8 or Type 42 clamps.
 - 6. Install individual, straight, horizontal piping runs:
 - a. 100 Ft. and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Ft.: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Ft. if Indicated: MSS Type 49, spring cushion rolls.
 - 7. Multiple, Straight, Horizontal Piping Runs 100 Ft. or Longer: MSS Type 44 pipe rolls. Support pipe rolls on trapeze.
 - 8. Base of Vertical Piping: MSS Type 52 spring hangers.
- C. Install hangers for cast-iron and copper soil piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting, **valve**, and coupling.
- E. Support vertical runs of cast-iron and copper soil piping to comply with MSS SP-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect waste and vent piping to the following:
 - 1. Plumbing Fixtures: Connect waste piping in sizes indicated, but not smaller than required by plumbing code.
 - 2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
 - 3. Plumbing Specialties: Connect waste and vent piping in sizes indicated, but not smaller than required by plumbing code.
 - 4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
 - 5. Install horizontal backwater valves with cleanout cover flush with floor.
 - 6. Comply with requirements for backwater valves, cleanouts, and drains specified in Section 221319 "Sanitary Waste Piping Specialties."

7. Equipment: Connect waste piping as indicated.
 - a. Provide shutoff valve if indicated and union for each connection.
 - b. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Connect force-main piping to the following:

1. Sanitary Sewer: To exterior force main.
2. Sewage Pump: To sewage pump discharge.

E. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

F. Make connections in accordance with the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed sanitary waste and vent piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
- B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections, and arrange for reinspection.
- C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.
- D. Test sanitary waste and vent piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
 1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced waste and vent piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Roughing-in Plumbing Test Procedure: Test waste and vent piping except outside leaders on completion of roughing-in.
 - a. Close openings in piping system and fill with water to point of overflow, but not less than 10 ft. head of water.
 - b. From 15 minutes before inspection starts to completion of inspection, water level must not drop.
 - c. Inspect joints for leaks.
 4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight.
 - a. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg.
 - b. Use U-tube or manometer inserted in trap of water closet to measure this pressure.
 - c. Air pressure must remain constant without introducing additional air throughout period of inspection.
 - d. Inspect plumbing fixture connections for gas and water leaks.
 5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 6. Prepare reports for tests and required corrective action.
- E. Test force-main piping in accordance with procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours.
 - b. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Protect sanitary waste and vent piping during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

- C. Place plugs in ends of uncompleted piping at end of day and when work stops.
- D. Repair damage to adjacent materials caused by waste and vent piping installation.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground, soil and waste piping NPS 4 and smaller are to be any of the following:
 - 1. Sewer and waste: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; Super-duty hubless-piping couplings; and coupled joints.
 - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- C. Aboveground, soil and waste piping NPS 5 and larger are to be any of the following:
 - 1. Sewer and waste: hubless, cast-iron soil pipe and fittings and hubless, single-stack aerator fittings; Super-duty hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- D. Aboveground, vent piping NPS 4 and smaller is to be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; CISPI, hubless-piping couplings; and coupled joints.
 - 2. Copper Type DWV tube, copper drainage fittings, and soldered joints.
 - a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- E. Aboveground, vent piping NPS 5 and **larger** is to be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; Super-duty hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- F. Underground, soil, waste, and vent piping NPS 4 and smaller are to be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; Super-duty cast-iron hubless-piping couplings; and coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.
- G. Underground, soil and waste piping NPS 5 and larger are to be any of the following:
 - 1. Hubless, cast-iron soil pipe and fittings; super-duty cast-iron hubless-piping couplings; coupled joints.
 - 2. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 221319 - SANITARY WASTE PIPING SPECIALTIES

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. Floor drains.
 - 2. Cleanouts.
 - 3. Miscellaneous sanitary drainage piping specialties.
- B. Related Requirements:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for metal roof flashing assemblies.
 - 2. Section 077200 "Roof Accessories" for preformed flashings.
 - 3. Section 078413 "Penetration Firestopping" for through-penetration firestop assemblies.
 - 4. Section 221423 "Storm Drainage Piping Specialties" for trench drains for storm water, channel drainage systems for storm water, roof drains, and catch basins.

1.3 DEFINITIONS

- A. ABS: Acrylonitrile butadiene styrene.
- B. PVC: Polyvinyl chloride.
- C. FOG: Fats, oils, and greases.
- D. HDPE: High-density polyethylene plastic.

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Soil, Waste, and Vent Piping: 10-foot head of water.
- B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.7 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.

- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.8 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.9 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.10 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.11 ACTION SUBMITTALS

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

1.12 SUBMITTAL DATA

- A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".

- b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.13 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.14 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.16 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.17 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate size and location of roof penetrations.

1.18 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.19 WARRANTY

- A. Listed manufacturers to provide labeling and warranty of their respective products.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTIONS

- A. Sanitary waste piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Comply with NSF 14 for plastic sanitary waste piping specialty components.

2.2 FLOOR DRAINS

- A. Cast-Iron Floor Drains:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.

- b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
- 2. Standard: ASME A112.6.3.
 - 3. Pattern: Floor drain.
 - 4. Body Material: Gray iron.
 - 5. Seepage Flange: Required.
 - 6. Anchor Flange: Required.
 - 7. Clamping Device: Required.
 - 8. Outlet: Bottom.
 - 9. Coating in first subparagraph below is usually used only on sanitary floor drains.
 - 10. Coating on Interior and Exposed Exterior Surfaces: Acid-resistant enamel.
 - 11. Sediment Bucket: Not required.
 - 12. Top or Strainer Material: Nickel bronze.
 - 13. Top of Body and Strainer Finish: Nickel bronze.
 - 14. Top Shape: Round.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
- 2. Size: Same as connected drainage piping.
- 3. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
- 4. Closure: Countersunk, brass plug.
- 5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Stainless Steel Exposed Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
- 2. Standard: ASME A112.3.1.
- 3. Size: Same as connected drainage piping.
- 4. Body Material: Stainless steel tee with side cleanout as required to match connected piping.
- 5. Closure: Stainless steel plug with seal.

C. Cast-Iron Exposed Floor Cleanouts:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
2. Standard: ASME A112.36.2M for threaded, adjustable housing cleanout.
 3. Size: Same as connected branch.
 4. Type: Threaded, adjustable housing.
 5. Body or Ferrule: Cast iron.
 6. Clamping Device: Required.
 7. Outlet Connection: Threaded.
 8. Closure: Brass plug with straight threads and gasket.
 9. Adjustable Housing Material: Cast iron with threads.
 10. Frame and Cover Material and Finish: Stainless steel.
 11. Frame and Cover Shape: Round.
 12. Top-Loading Classification: Heavy Duty.
 13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.

D. Stainless Steel Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
2. Standards: ASME A112.3.1[; **NSF listed**].
3. Size: Same as connected branch.
4. Housing: Type 316 stainless steel.
5. Closure: Stainless steel with seal.
6. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
7. Body or Ferrule: Stainless steel.
8. Clamping Device: Required.
9. Outlet Connection: Threaded.
10. Adjustable Housing Material: Cast iron with threads.
11. Frame and Cover Material and Finish: Stainless steel.
12. Frame and Cover Shape: Round.
13. Top-Loading Classification: Heavy Duty.

E. Cast-Iron Wall Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure Plug:

- a. Brass.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
6. Wall Access, Cover Plate: Round, flat, chrome-plated brass, or stainless-steel cover plate with screw.
 7. Wall Access, Frame and Cover: Round, stainless steel.

2.4 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains:

1. Description: Shop or field fabricate from ASTM A74, Service Class, hubless, cast-iron soil-pipe fittings. Include P-trap, hubless riser section; and where required, increaser fitting joined with ASTM C564 rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Vent Caps:

1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
2. Size: Same as connected stack vent or vent stack.
3. inside of flashing collar extension, with counterflashing.

D. Expansion Joints:

1. Standard: ASME A112.6.4.
2. Body: Cast iron with bronze sleeve, packing, and gland.
3. End Connections: Matching connected piping.
4. Size: Same as connected soil, waste, or vent piping.

PART 3 - EXECUTION

3.1 INSTALLATION

- #### A. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 4. Locate at base of each vertical soil and waste stack.
- B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- D. Assemble open drain fittings and install with top of hub 2 inches above floor.
- E. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- F. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- G. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- H. Install sleeve and sleeve seals with each riser and stack passing through floors with waterproof membrane.
- I. Install vent caps on each vent pipe passing through roof.
- J. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- K. Install wood-blocking reinforcement for wall-mounting-type specialties.
- L. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

3.2 PIPING CONNECTIONS

- A. Comply with requirements in Section 221316 "Sanitary Waste and Vent Piping" for piping installation requirements. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to equipment, to allow service and maintenance.

3.3 LABELING AND IDENTIFYING

- A. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit.
1. Nameplates and signs are specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221319

SECTION 221413 - FACILITY STORM DRAINAGE PIPING

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. Hubless, cast-iron soil pipe and fittings.
 - 2. Specialty pipe and fittings.
 - 3. Encasement for underground metal piping.
- B. Related Requirements:
 - 1. Section 334400 "Stormwater Utility Equipment" for storm drainage piping outside the building.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
- B. Seismic Performance: Storm drainage piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 UTILITIES

- A. See Drawings for Points of Connection.
- B. Certain site utilities are to be connected to and extended. Before laying of any pipe or digging of any trenches, Contractor shall determine by actual excavation and measurement exact location and depth of lines to which he is to connect. In event depth of lines is not sufficient to permit connection in manner

indicated, Contractor shall obtain direction from the Owner's representative before proceeding with this work.

- C. Verify that utility companies size their services and meters to suit ultimate demand indicated on the drawings.
- D. Storm Drain: The Contractor shall be responsible for the storm drain service outside of the building within five feet (5') of the foundation, and within the building itself. See Civil Engineer's plans for onsite storm drain system.

1.9 EXAMINATION OF PREMISES

- A. Before bidding on this work, Contractors shall make a careful examination of the premises and shall thoroughly familiarize themselves with the requirements of the contract. By the act of submitting a proposal for the work included in this contract, the Contractor shall be deemed to have made such study and examination, and that he is familiar with and accepts all conditions of the site.

1.10 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.11 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.12 ACTION SUBMITTALS

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

1.13 SUBMITTAL DATA

A. Submittal Requirements:

1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.

- a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
 3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
 4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
 5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
 6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.14 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.16 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.17 FIELD CONDITIONS

- A. Interruption of Existing Storm Drainage 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 according to requirements indicated:
 - 1. Notify Architect Construction Manager no fewer than two days in advance of proposed interruption of storm drainage service.
 - 2. Do not proceed with interruption of storm drainage service without Architect's Construction Manager's written permission.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
 - 1. Storm Drainage Piping: 10-foot head of water.
 - 2. Storm Drainage, Force-Main Piping: 150 psig.

2.2 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Charlotte Pipe.
 - 2. Tyler Pipe.
 - 3. AB&I Foundry.
- B. Pipe and Fittings:
 - 1. Marked with CISPI collective trademark and NSF certification mark.
 - 2. Standard: ASTM A 888 or CISPI 301.

C. Super-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ANACO-Husky SD 4000 series.
 - b. Clamp All HI_TORQ 125 series
2. Standard: ASTM C 1540.
3. Description: Stainless-steel shield (minimum thickness .015 mm) with stainless-steel bands and tightening devices; and ASTM C 564, neoprene sleeve with integral, center pipe stop.

2.3 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in ODs or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified-piping-system fitting.
3. Unshielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1173.
 - b. Description: Elastomeric sleeve, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. Sleeve Materials:
 - 1) For Cast-Iron Soil Pipes: ASTM C 564, rubber.
 - 2) For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
 - 3) For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
4. Shielded, Nonpressure Transition Couplings:
 - a. Standard: ASTM C 1460.
 - b. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.
 - c. End Connections: Same size as and compatible with pipes to be joined.
5. Pressure Transition Couplings:
 - a. Standard: AWWA C219.
 - b. Description: Metal, sleeve-type couplings same size as pipes to be joined, and with pressure rating at least equal to and ends compatible with pipes to be joined.
 - c. Center-Sleeve Material: Manufacturer's standard.
 - d. Gasket Material: Natural or synthetic rubber.
 - e. Metal Component Finish: Corrosion-resistant coating or material.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

2. Dielectric Unions:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Pressure Rating: 150 psig minimum at 180 deg F.
 - 3) End Connections: Solder-joint copper alloy and threaded ferrous.
3. Dielectric Flanges:
 - a. Description:
 - 1) Standard: ASSE 1079.
 - 2) Factory-fabricated, bolted, companion-flange assembly.
 - 3) Pressure Rating: 150 psig minimum at 180 deg F.
 - 4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.
4. Dielectric-Flange Insulating Kits:
 - a. Description:
 - 1) Nonconducting materials for field assembly of companion flanges.
 - 2) Pressure Rating: 150 psig.
 - 3) Gasket: Neoprene or phenolic.
 - 4) Bolt Sleeves: Phenolic or polyethylene.
 - 5) Washers: Phenolic with steel-backing washers.
5. Dielectric Nipples:
 - a. Description: Electroplated steel nipple.
 - b. Standard: IAPMO PS 66.
 - c. Pressure Rating: 300 psig at 225 deg F.
 - d. End Connections: Male threaded or grooved.
 - e. Lining: Inert and noncorrosive, propylene.

2.4 ENCASEMENT FOR UNDERGROUND METAL PIPING

- A. Standard: ASTM A 674 or AWWA C105/A 21.5.
- B. Material: High-density, cross laminated polyethylene film of 0.004-inch minimum thickness.
- C. Form: Sheet or tube.
- D. Color: Black.
- E. The minimum Polywrap flat tube width for each pipe diameter shall be as follows:

<u>Pipe Size / Type</u>	<u>Polywrap Flat Tube Width</u>
2" copper	4"
2-1/2" copper	5"
3" copper	6"

2" to 3" cast iron	14"
4" cast iron	16"
6" cast iron	20"
8" cast iron	24"

- F. Piping through exterior walls shall be sealed using Link Seal modular seal with nitrile seal elements and stainless-steel bolts.

PART 3 - EXECUTION

3.1 EARTH MOVING

- A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems.
1. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations.
 2. Install piping as indicated unless deviations from layout are approved on coordination drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- K. Make changes in direction for piping using appropriate branches, bends, and long-sweep bends.
1. Do not change direction of flow more than 90 degrees.
 2. Use proper size of standard increasers and reducers if pipes of different sizes are connected.

- a. Reducing size of drainage piping in direction of flow is prohibited.
- L. Lay buried building piping beginning at low point of each system.
 - 1. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream.
 - 2. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
 - 3. Maintain swab in piping and pull past each joint as completed.
- M. Install piping at the following minimum slopes unless otherwise indicated:
 - 1. Building Storm Drain: **2** percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
 - 2. Horizontal Storm Drainage Piping: **1** percent downward in direction of flow.
- N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
 - 1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
- O. Install steel piping according to applicable plumbing code.
- P. Install engineered controlled-flow drain specialties and storm drainage piping in locations indicated.
- Q. Plumbing Specialties:
 - 1. Install backwater valves in storm drainage gravity-flow piping.
 - a. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."
 - 2. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping.
 - a. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.
 - b. Comply with requirements for cleanouts specified in Section 221423 "Storm Drainage Piping Specialties."
 - 3. Install drains in storm drainage gravity-flow piping.
 - a. Comply with requirements for drains specified in Section 221423 "Storm Drainage Piping Specialties."
- R. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
- S. Install sleeves for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

- T. Install sleeve seals for piping penetrations of concrete walls and slabs.
 - 1. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
- U. Install escutcheons for piping penetrations of walls, ceilings, and floors.
 - 1. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

- A. Hubless, Cast-Iron Soil Piping Coupled Joints:
 - 1. Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
- B. Grooved Joints: Cut groove ends of pipe according to AWWA C606. Lubricate and install gasket over ends of pipes or pipe and fittings. Install coupling housing sections, over gasket, with keys seated in piping grooves. Install and tighten housing bolts.
- C. Flanged Joints: Align bolt holes. Select appropriate gasket material, size, type, and thickness. Install gasket concentrically positioned. Use suitable lubricants on bolt threads. Torque bolts in cross pattern.
- D. Joint Restraints and Sway Bracing:
 - 1. Provide joint restraints and sway bracing for storm drainage piping joints to comply with the following conditions:
 - a. Provide axial restraint for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction, branches, and changes in diameter greater than two pipe sizes.
 - b. Provide rigid sway bracing for pipe and fittings 4 inches and larger, upstream and downstream of all changes in direction 45 degrees and greater.
 - c. Provide rigid sway bracing for pipe and fittings 5 inches and larger, upstream and downstream of all changes in direction and branch openings.

3.4 SPECIALTY PIPE FITTING INSTALLATION

- A. Transition Couplings:
 - 1. Install transition couplings at joints of piping with small differences in ODs.
 - 2. In Drainage Piping: Shielded, nonpressure transition couplings.
 - 3. In Aboveground Force-Main Piping: Fitting-type transition couplings.
 - 4. In Underground Force-Main Piping:
 - a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
 - b. NPS 2 and Larger: Pressure transition couplings.
- B. Dielectric Fittings:
 - 1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges or flange kits.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 VALVE INSTALLATION

- A. General valve installation requirements for general-duty valve installations are specified in the following Sections:
 1. Section 220523 "General-Duty Valves for Plumbing Piping."
- B. Shutoff Valves:
 1. Install shutoff valve on each sump pump discharge.
 2. Install full port ball valve for piping NS 2 and smaller.
 3. Install gate valve for piping NPS 2-1/2 and larger.
- C. Check Valves: Install swing-check valve, between pump and shutoff valve, on each sump pump discharge.
- D. Backwater Valves: Install backwater valves in piping subject to backflow.
 1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
 2. Install backwater valves in accessible locations.
 3. Comply with requirements for backwater valves specified in Section 221423 "Storm Drainage Piping Specialties."

3.6 INSTALLATION OF HANGERS AND SUPPORTS

- A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
- B. Comply with requirements for hangers, supports, and anchor devices specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
 1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
 2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
 3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
 4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
 5. Vertical Piping: MSS Type 8 or Type 42, clamps.
 6. Install individual, straight, horizontal piping runs:
 - a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
 - b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
 - c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.
 7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
 8. Base of Vertical Piping: MSS Type 52, spring hangers.

- C. Install hangers for cast-iron galvanized steel ductile iron and copper soil tubing and piping, with maximum horizontal spacing and minimum rod diameters, to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent.
- D. Support horizontal piping and tubing within 12 inches of each fitting, **valve**, and coupling.
- E. Support vertical cast-iron galvanized steel ductile iron and copper tubing and piping to comply with MSS-58, locally enforced codes, and authorities having jurisdiction requirements, whichever are most stringent, but as a minimum at base and at each floor.

3.7 CONNECTIONS

- A. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.
- C. Connect storm drainage piping to roof drains and storm drainage specialties.
 - 1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
 - 2. Install horizontal backwater valves with cleanout cover flush with floor.
 - 3. Comply with requirements for backwater valves cleanouts and drains specified in Section 221423 "Storm Drainage Piping Specialties."
- D. Where installing piping adjacent to equipment, allow space for service and maintenance.
- E. Make connections according to the following unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.8 IDENTIFICATION

- A. Identify exposed storm drainage piping.
- B. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

- A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
 - 1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
 - 2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

- B. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired.
 - a. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
 2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 3. Test Procedure:
 - a. Test storm drainage piping on completion of roughing-in.
 - b. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts until completion of inspection, water level must not drop. Inspect joints for leaks.
 4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 5. Prepare reports for tests and required corrective action.
- C. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved.
 - a. Expose work that was covered or concealed before it was tested.
 2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials.
 - a. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
 3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
 4. Prepare reports for tests and required corrective action.
- D. Piping will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.10 CLEANING AND PROTECTION

- A. Clean interior of piping. Remove dirt and debris as work progresses.

- B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
- C. Place plugs in ends of uncompleted piping at end of day and when work stops.

3.11 PIPING SCHEDULE

- A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
- B. Aboveground and underground storm drainage piping shall be the following:
 - 1. Hubless, cast-iron soil pipe and fittings; Super-duty, hubless-piping couplings; and coupled joints.
 - 2. Galvanized-steel pipe, drainage fittings, and threaded joints.
 - 3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221413

SECTION 221423 - STORM DRAINAGE PIPING SPECIALTIES

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. Metal roof drains.
 - 2. Miscellaneous storm drainage piping specialties.
 - 3. Cleanouts.
- B. Related Requirements:
 - 1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
 - 2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

- C. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.7 ACTION SUBMITTALS

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

1.8 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each

- submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed

comparison of every significant characteristic for which the specified item was analyzed during design.

2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.9 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.10 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.11 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 METAL ROOF DRAINS

A. Cast-Iron, Large-Sump, General-Purpose Roof Drains:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
- 2. Standard: ASME A112.6.4.
- 3. Body Material: Cast iron.
- 4. Dimension of Body: Nominal 14-to 16-inch diameter.
- 5. Combination Flashing Ring and Gravel Stop: See Plumbing Fixture Schedule.
- 6. Flow-Control Weirs: See Plumbing Fixture Schedule.
- 7. Outlet: See Plumbing Fixture Schedule.
- 8. Outlet Type: See Plumbing Fixture Schedule.
- 9. Extension Collars: See Plumbing Fixture Schedule.
- 10. Underdeck Clamp: See Plumbing Fixture Schedule.
- 11. Expansion Joint: See Plumbing Fixture Schedule and plans.
- 12. Sump Receiver Plate: See Plumbing Fixture Schedule.
- 13. Dome Material: Cast iron.
- 14. Perforated Gravel Guard: Stainless-steel.
- 15. Vandal-Proof Dome: Required.
- 16. Water Dam: 2 inches (Overflow drains only).

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adapters:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
- 2. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior sheet metal downspout.
- 3. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
2. Description: Manufactured, ASTM A48/A48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
3. Size: Inlet size to match downspout and NPS 4 outlet.

C. Metal Downspout Nozzles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
2. Description: Nozzle with wall flange and mounting holes to cover rough opening and serve as anchor.
3. Size: Same as connected downspout.
4. Material: Cast bronze or nickel bronze nozzle and flange.
5. Piping Connection Type: See Plumbing Fixture Schedule.
6. Finish: See Plumbing Fixture Schedule.
7. Opening Protection: See Plumbing Fixture Schedule.

2.3 CLEANOUTS

A. Cast-Iron Exposed Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
2. Standard: ASME A112.36.2M.
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: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

B. Cast-Iron Exposed Floor Cleanouts:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.

- c. Watts; a division of Watts Water Technologies, Inc.
 - 2. Standard: ASME A112.36.2M.
 - 3. Size: Same as connected branch.
 - 4. Type: Threaded, adjustable housing.
 - 5. Body or Ferrule: Cast iron.
 - 6. Clamping Device: Required.
 - 7. Outlet Connection: Threaded.
 - 8. Closure: Brass plug with straight threads and gasket.
 - 9. Adjustable Housing Material: Cast iron with threads.
 - 10. Frame and Cover Material and Finish: Stainless steel.
 - 11. Frame and Cover Shape: Round.
 - 12. Top-Loading Classification: Heavy Duty.
 - 13. Riser: ASTM A74, Service Class, cast-iron drainage pipe fitting and riser to cleanout.
- C. Cast-Iron Wall Cleanouts:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
 - 2. Standard: ASME A112.36.2M. Include wall access.
 - 3. Size: Same as connected drainage piping.
 - 4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
 - 5. Closure Plug:
 - a. Brass.
 - b. Countersunk head.
 - c. Drilled and threaded for cover attachment screw.
 - d. Size: Same as or not more than one size smaller than cleanout size.
 - 6. Wall Access, Cover Plate: Round, flat, chrome-plated brass, or stainless-steel cover plate with screw.
 - 7. Wall Access, Frame and Cover: Round, stainless steel.
- D. Test Tees:
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
 - 2. Standard: ASME A112.36.2M and ASTM A74, ASTM A888, or CISPI 301.
 - 3. Size: Same as connected drainage piping.
 - 4. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
 - 5. Closure Plug: Countersunk, brass.
 - 6. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install roof drains at low points of roof areas in accordance with roof membrane manufacturer's written installation instructions.
 - 1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
 - 2. Install expansion joints, if indicated, in roof drain outlets.
 - 3. Position roof drains for easy access and maintenance.
- B. Install downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.
- C. Install downspout boots at grade with top 9 inches above grade. Secure to building wall.
- D. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.
- E. Install cleanouts in aboveground piping and building drain piping in accordance with the following instructions unless otherwise indicated:
 - 1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
 - 3. Locate cleanouts at minimum intervals of 100 feet for piping all piping.
 - 4. Locate cleanouts at base of each vertical storm piping conductor.
- F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- H. Install test tees in vertical conductors and near floor.
- I. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.
- J. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
 - 1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 CONNECTIONS

- A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 INSTALLATION OF FLASHING

- A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 221423

SECTION 223300 - ELECTRIC, DOMESTIC-WATER HEATERS

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. Commercial, electric, storage, domestic-water heaters.
 - 2. Domestic-water heater accessories.

1.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.4 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.5 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.6 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.7 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.8 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.9 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.10 ACTION SUBMITTALS

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

1.11 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

- 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.12 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For electric, domestic-water heaters to include emergency, operation, and maintenance manuals.

1.13 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.14 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.15 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.16 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

1.17 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
 - a. Structural failures including storage tank and supports.
 - b. Faulty operation of controls.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
 - a. Commercial, Electric, Storage, Domestic-Water Heaters:
 - 1) Storage Tank: Five years.
 - 2) Controls and Other Components: Five years.
 - b. Electric, Tankless, Domestic-Water Heaters: Five year(s).
 - c. Expansion Tanks: Five years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.
- B. Seismic Performance: Commercial, electric, domestic-water heaters shall withstand the effects of earthquake motions determined in accordance with [ASCE/SEI 7] <Insert requirement>.
 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
 2. Component Importance Factor: 1.5.
- C. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.
- D. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
- E. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

- A. Commercial, Electric, Storage, Domestic-Water Heaters:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - b. American Water Heater.
 - c. Bradford White Corporation.

- d. Rheem Manufacturing Company.
2. Lochinvar, LLC Source Limitations: Obtain domestic-water heaters from single source from single manufacturer.
3. Standard: UL 1453.
4. Storage-Tank Construction: ASME-code, steel vertical arrangement.
 - a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
 - 1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
 - 2) 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. Factory-Installed, Storage-Tank Appurtenances:
 - a. Anode Rod: Replaceable magnesium.
 - b. Drain Valve: Corrosion-resistant metal with hose-end connection.
 - c. Insulation: Comply with ASHRAE/IES 90.1.
 - d. Jacket: Steel with enameled finish or high-impact composite material.
 - e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
 - f. Temperature Control: Adjustable thermostat.
 - g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
 - h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.
6. Special Requirements: NSF 5 construction.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. AMTROL Inc.
 - b. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
 - c. Taco, Inc.
2. Source Limitations: Obtain domestic-water expansion tanks from single source from single manufacturer.
3. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
4. Construction:

- a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
 - b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
 - c. Air-Charging Valve: Factory installed.
5. Capacity and Characteristics:
 - a. Working-Pressure Rating: 150 psig.
 - b. Capacity Acceptable: See Plumbing Fixture Schedule and Details.
- B. Drain Pans: Corrosion-resistant metal with raised edge. Comply with ANSI/CSA LC 3. Include dimensions not less than base of domestic-water heater and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads or with ASME B1.20.7 garden-hose threads.
- C. Manifold Kits: Domestic-water-heater manufacturer's factory-fabricated inlet and outlet piping for field installation, for multiple domestic-water heater installation. Include ball-, butterfly-, or gate-type shutoff valves to isolate each domestic-water heater and calibrated balancing valves to provide balanced flow through each domestic-water heater.
 1. Comply with requirements for ball-, butterfly-, or gate-type shutoff valves specified in Section 220523.12 "Ball Valves for Plumbing Piping," Section 220523.13 "Butterfly Valves for Plumbing Piping," and Section 220523.15 "Gate Valves for Plumbing Piping."
 2. Comply with requirements for balancing valves specified in Section 221119 "Domestic Water Piping Specialties."
- D. Pressure-Reducing Valves: ASSE 1003 for water. Set at 25-psig-maximum outlet pressure unless otherwise indicated.
- E. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.
- F. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.
- G. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.
- H. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.
- I. Domestic-Water Heater Suspended Platform: Manufacturer's factory-fabricated steel suspended platform for wall mounting, capable of supporting domestic-water heater and water. Include dimension that will support bottom of domestic-water heater a minimum of 72 inches above the floor.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holdright: Reliance Worldwide Corporation (RWC).
- J. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Holdright: Reliance Worldwide Corporation (RWC).

2.4 SOURCE QUALITY CONTROL

- A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.
- B. Hydrostatically test commercial domestic-water heaters to minimum of one and one-half times pressure rating before shipment.
- C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

- A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 033000 "Cast-in-Place Concrete."
 1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on a suspended platform, or directly on floor is indicated (for floors above ground level).
 2. Maintain manufacturer's recommended clearances.
 3. Arrange units so controls and devices that require servicing are accessible.
 4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 7. Install anchor bolts to elevations required for proper attachment to supported equipment.
 8. Anchor domestic-water heaters to substrate.
- B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
 1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- C. Install commercial, electric, domestic-water heaters with seismic-restraint devices. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."

- D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- E. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.
- F. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Section 221119 "Domestic Water Piping Specialties."
- G. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- H. Install thermometers on inlet and outlet piping of residential, solar, electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- I. Assemble and install inlet and outlet piping manifold kits for multiple electric, domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each electric, domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each electric, domestic-water heater outlet. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers specified in Section 220519 "Meters and Gages for Plumbing Piping."
- J. Install pressure-reducing valve with integral bypass relief valve in electric, domestic-water booster-heater inlet piping and water hammer arrester in booster-heater outlet piping. Set pressure-reducing valve for outlet pressure of 25 psig. Comply with requirements for pressure-reducing valves and water hammer arresters specified in Section 221119 "Domestic Water Piping Specialties."
- K. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.
- L. Fill electric, domestic-water heaters with water.
- M. Charge domestic-water expansion tanks with air to required system pressure.
- N. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water shall contain less than 0.25 percent of lead by weight.

3.2 PIPING CONNECTIONS

- A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 IDENTIFICATION

- A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- C. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- D. Perform tests and inspections with the assistance of a factory-authorized service representative.
- E. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.

3.5 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial and tankless, electric, domestic-water heaters. Training shall be a minimum of two hour(s).

END OF SECTION 223300

SECTION 224213.13 - COMMERCIAL WATER CLOSETS

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Floor-mounted water closets.
 - 2. Flushometer valves.
 - 3. Toilet seats.
 - 4. Supports.

1.2 DEFINITIONS

- A. Standard-Efficiency Flush Volume: 1.6 gal. per flush.
- B. High-Efficiency Flush Volume: 1.28 gal. or less per flush (Standard for California).
- C. WaterSense Fixture: Water closet and/or flushometer valve/tank certified by the EPA to meet the WaterSense performance criteria.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body having jurisdiction thereof.
 - 9. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.
 - 10. All single-user toilet facilities shall be identified as a Gender-Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.2.6.3. no pictogram, text or braille is

required on the symbol. If a tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are "ALL-GENDER RESTROOM", "RESTROOM", OR "UNISEX RESTROOM". DSA BU 17-01.

11. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.
12. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his

equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for water closets.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:

- a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
- b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
- c. Include all pertinent construction, installation, performance, and technical data.
- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the

Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Materials: Furnish extra materials to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

- 1. Comply with ASME A112.19.2/CSA B45.1 for water closets.
- 2. Comply with ASME A112.19.5/CSA B45.15 for flush valves and spuds for water closets and tanks.
- 3. Comply with ASSE 1037/ASME A112.1037/CSA B125.37 for flush valves.
- 4. Comply with IAMPO/ANSI Z124.5 for water-closet (toilet) seats.
- 5. Comply with ASME A112.6.1M for water-closet supports.
- 6. Comply with ICC A117.1 for ADA-compliant water closets.
- 7. Comply with ASTM A1045 for flexible PVC gaskets used in connection of vitreous china water closets to sanitary drainage systems.
- 8. Comply with ASME A112.4.3 for plastic fittings used in connection of vitreous china water closets to sanitary drainage systems.

2.2 FLOOR-MOUNTED, BOTTOM-OUTLET WATER CLOSETS

A. Water Closets - Floor Mounted, Bottom Outlet, Top Spud:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
- 2. Source Limitations: Obtain water closets from single source from single manufacturer.
- 3. Bowl:
 - a. Material: Vitreous china.
 - b. Type: Siphon jet.
 - c. Style: Flushometer valve.
 - d. Height: See Plumbing Fixture Schedule.
 - e. Rim Contour: Elongated.
 - f. Water Consumption: 1.28 gal. per flush.
 - g. Spud Size and Location: NPS 1-1/2; top.
 - h. Color: White.

2.3 FLUSHOMETER VALVES

A. Flushometer Valves - Diaphragm, Lever Handle:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Sloan Valve Company.
2. Source Limitations: Obtain flushometer valve from single source from single manufacturer.
3. Minimum Pressure Rating: 125 psig.
4. Features: Include integral check stop and backflow-prevention device.
5. Material: Brass body with corrosion-resistant components.
6. Style: Exposed.
7. Flushometer-Valve Finish: Chrome-plated.
8. Handle Finish: Chrome-plated.
9. Consumption: 1.28 gal.
10. Minimum Inlet: NPS 1.
11. Minimum Outlet: NPS 1-1/4.

2.4 TOILET SEATS

A. Toilet Seats:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Bemis Manufacturing Company.
 - b. Olsonite Seat Co.
2. Source Limitations: Obtain toilet seat from single source from single manufacturer.
3. Material: Plastic.
4. Type: Commercial (Heavy duty).
5. Shape: Elongated rim, open front.
6. Hinge: Self-sustaining, check.
7. Hinge Material: Noncorroding metal.
8. Seat Cover: Required.
9. Color: White.
10. Surface Treatment: Not required.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before water-closet installation.
- B. Examine walls and floors for suitable conditions where water closets will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

COMMERCIAL WATER CLOSETS

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3.2 INSTALLATION, GENERAL

A. Water-Closet Installation:

1. Install level and plumb.
2. Install floor-mounted water closets on bowl-to-drain connecting fitting attachments to piping or building substrate.
3. Install accessible, wall-mounted water closets at mounting height in accordance with ICC A117.1.

B. Support Installation:

1. Install supports, affixed to building substrate, for floor-mounted, back-outlet water closets.
2. Use carrier supports with waste-fitting assembly and seal.
3. Install floor-mounted, back-outlet water closets attached to building floor substrate, onto waste-fitting seals; and attach to support.
4. Install wall-mounted, back-outlet water-closet supports with waste-fitting assembly and waste-fitting seals; and affix to building substrate.
5. Measure support height installation from finished floor, not structural floor.

C. Flushometer-Valve Installation:

1. Install flushometer-valve, water-supply fitting on each supply to each water closet.
2. Attach supply piping to supports or substrate within pipe spaces behind fixtures.
3. Install lever-handle flushometer valves for accessible water closets with handle mounted on open side of water closet.
4. Install actuators in locations easily reachable for people with disabilities.
5. Install new batteries in battery-powered, electronic-sensor mechanisms.

D. Install toilet seats on water closets.

E. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

F. Joint Sealing:

1. Seal joints between water closets and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

A. Connect water closets with water supplies and soil, waste, and vent piping. Use size fittings required to match water closets.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to water closets, allow space for service and maintenance.

3.4 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."

3.5 ADJUSTING

- A. Operate and adjust water closets and controls. Replace damaged and malfunctioning water closets, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. Clean water closets and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed water closets and fittings.
- C. Do not allow use of water closets for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.13

SECTION 224213.16 - COMMERCIAL URINALS

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. Hybrid-waterless urinals.
 - 2. Supports.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
 - 9. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.
 - 10. All single-user toilet facilities shall be identified as a Gender-Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.2.6.3. no pictogram, text or braille is required on the symbol. If a tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate designations are "ALL-GENDER RESTROOM", "RESTROOM", OR "UNISEX RESTROOM". DSA BU 17-01.
 - 11. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.

12. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for urinals.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.

- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

- 1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
- 2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
- 3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
- 4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
- 5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.

6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For flushometer valves to include in operation and maintenance manuals.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents.
 1. Flushometer-Valve Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than six of each type.
 2. Waterless Urinal Trap-Seal Cartridges: Equal to 200 percent of amount of each type installed, but no fewer than 12 of each type.
 3. Waterless Urinal Trap-Seal Liquid: Equal to 1 gal. for each urinal installed.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.

- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 HYBRID-WATERLESS URINALS

- A. Urinals - Wall Hung, Back Outlet, Waterless, Vitreous China:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - c. Sloan Valve Co.
 - 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1, except without water supply.
 - b. Trap-Seal Method: Proprietary cartridge with liquid seal.
 - c. Outlet Size and Location: NPS 2 flange; back.
 - d. Trap-Sealing Liquid: Proprietary.
 - e. Color: White.
 - 3. Waste Fitting:
 - a. Standard: ASME A112.18.2/CSA B125.2 for transition coupling, trap, and waste pipe.
 - b. Size: NPS 2.
 - 4. Support: Type I urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture. Include rectangular, steel uprights.
 - 5. Urinal Mounting Height: See Plumbing Fixture Schedule.

2.2 SUPPORTS

- A. Urinal Carrier:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - 2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before urinal installation.
- B. Examine walls and floors for suitable conditions where urinals will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Urinal Installation:

- 1. Install urinals level and plumb according to rough-in drawings.
- 2. Install wall-hung, back-outlet urinals onto waste fitting seals and attached to supports.
- 3. Install wall-hung, bottom-outlet urinals with tubular waste piping attached to supports.
- 4. Install accessible, wall-mounted urinals at mounting height for the handicapped/elderly, according to ICC A117.1.
- 5. Install trap-seal liquid in waterless urinals.
- 6. Install 3/4" cold water and provide chrome escutcheon for future flush valve.

B. Support Installation:

- 1. Install supports, affixed to building substrate, for wall-hung urinals.
- 2. Use carriers without waste fitting for urinals with tubular waste piping.
- 3. Use chair-type carrier supports with rectangular steel uprights for urinals.

C. Wall Flange and Escutcheon Installation:

- 1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations.
- 2. Install deep-pattern escutcheons if required to conceal protruding fittings.
- 3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

D. Joint Sealing:

- 1. Seal joints between urinals and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
- 2. Match sealant color to urinal color.
- 3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect urinals with water supplies and soil, waste, and vent piping. Use size fittings required to match urinals.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."
- D. Where installing piping adjacent to urinals, allow space for service and maintenance.

3.4 ADJUSTING

- A. Operate and adjust urinals and controls. Replace damaged and malfunctioning urinals, fittings, and controls.
- B. Adjust water pressure at flushometer valves to produce proper flow.
- C. Install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. Clean urinals and fittings with manufacturers' recommended cleaning methods and materials.
- B. Install protective covering for installed urinals and fittings.
- C. Do not allow use of urinals for temporary facilities unless approved in writing by Owner.

END OF SECTION 224213.16

SECTION 224216.13 - COMMERCIAL LAVATORIES

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. Vitreous-china, wall-mounted lavatories.
 - 2. Manually operated lavatory faucets.
 - 3. Supply fittings.
 - 4. Waste fittings.
 - 5. Lavatory supports.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
 - 9. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.
 - 10. All single-user toilet facilities shall be identified as a Gender-Neutral facilities by a door symbol that complies with CBC Sections 11B-216.8 and 11B-703.2.6.3. no pictogram, text or braille is required on the symbol. If a tactile jamb signage is provided, the signage shall comply with the appropriate technical requirements of CBC Section 11B-703. Examples of appropriate

designations are "ALL-GENDER RESTROOM", "RESTROOM", OR "UNISEX RESTROOM". DSA BU 17-01.

11. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.
12. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.
13. Accessible fixture controls shall comply with CBC Sections 11B-611.3 for lavatories and sinks.
14. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surface 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC 11B-306 when forward approach is required CBC Sections 11B-606.3 and 11B606.7.
15. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories or sinks. CBC Section 11B-606.5.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.

3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
 - e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.

3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
 2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions,

depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 VITREOUS-CHINA, WALL-MOUNTED LAVATORIES

- A. Lavatory - Vitreous China, Wall Mounted, with Back:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard America.
 - b. Kohler Co.
 - 2. Fixture:
 - a. Standard: ASME A112.19.2/CSA B45.1.
 - b. Type: For wall hanging.
 - c. Nominal Size: Rectangular, See Plumbing Fixture Schedule.
 - d. Faucet-Hole Punching: See Plumbing Fixture Schedule.
 - e. Faucet-Hole Location: Top.
 - f. Color: White.
 - g. Mounting Material: Chair carrier.
 - 3. Faucet: Manually Operated Lavatory Faucets.
 - 4. Support: Type II, concealed-arm lavatory carrier. Include rectangular, steel uprights.
 - 5. Lavatory Mounting Height: Handicapped/elderly in accordance with ICC A117.1.

2.2 MANUALLY OPERATED LAVATORY FAUCETS

- A. Lavatory faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ),

and with NSF 61/NSF 372, or be certified in compliance with NSF 61/NSF 372 by an American National Standards Institute (ANSI) accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.

B. Lavatory Faucets - Manual Type: Single-Control Nonmixing, Commercial:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
2. Standard: ASME A112.18.1/CSA B125.1.
3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punchings; coordinate outlet with spout and fixture receptor.
4. Body Type: See Plumbing Fixture Schedule.
5. Body Material: Commercial, solid-brass, or die-cast housing with brazed copper and brass waterway.
6. Finish: See Plumbing Fixture Schedule.
7. Maximum Flow Rate: 0.5 gpm.
8. Maximum Flow: 0.25 gal. per metering cycle.
9. Mounting Type: **[Deck, exposed]** **[Deck, concealed]** **[Back/wall, exposed]** **[Back/wall, concealed]**.
10. Valve Handle(s): Push button.
11. Spout: Rigid type.
12. Spout Outlet: Aerator.
13. Operation: Compression, manual.
14. Drain: Not part of faucet.

2.3 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.
- D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type, or compression valve with inlet connection matching supply piping.
- E. Operation: **Loose key**.
- F. Risers:
 1. NPS ½.
 2. Chrome-plated, soft-copper flexible tube riser.

2.4 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.

B. Drain: Grid type with NPS 1-1/4 offset and straight tailpiece.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. McGuire Manufacturing.

C. Trap:

1. Size: NPS 1-1/2 by NPS 1-1/4.

2. Standard or ADA with Protective Shroud Material:

a. Chrome-plated, two-piece, cast-brass trap, and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.

3. ADA Material:

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) McGuire Manufacturing.

b. Pre-wrapped p-trap & trap arm with sleeve for tailpiece and supply covers; and chrome-plated, brass or steel wall flange.

2.5 LAVATORY SUPPORTS

A. Lavatory Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Zurn Industries, LLC; Plumbing Products Group.

1) Single wall hung lavatory

a) Z1231EZ-WL

2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before lavatory installation.

B. Examine counters and walls for suitable conditions where lavatories will be installed.

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

3.2 INSTALLATION

- A. Install lavatories level and plumb in accordance with roughing-in drawings.
- B. Install supports, affixed to building substrate, for wall-mounted lavatories.
- C. Install accessible wall-mounted lavatories at handicapped/elderly mounting height for people with disabilities or the elderly, in accordance with ICC A117.1.
- D. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- E. Seal joints between lavatories, counters, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- F. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Operate and adjust lavatories and controls. Replace damaged and malfunctioning lavatories, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

- A. After completing installation of lavatories, inspect and repair damaged finishes.
- B. Clean lavatories, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed lavatories and fittings.
- D. Do not allow use of lavatories for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.13

SECTION 224216.16 - COMMERCIAL SINKS

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. Classroom sinks
 - 2. Sinks
 - 3. Service sinks.
 - 4. Manually operated sink faucets.
 - 5. Automatically operated sink faucets.
 - 6. Supply fittings.
 - 7. Waste fittings.
 - 8. Sink supports.
 - 9. Grout.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
 - 9. Plumbing fixtures and accessories provided in a toilet room or bathing room required to comply with CBC Section 11B-213.2 shall comply with CBC Section 11B-213.3.
 - 10. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.
 - 11. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.
 - 12. Accessible fixture controls shall comply with CBC Sections 11B-611.3 for lavatories and sinks.

13. Accessible lavatories and sinks shall be mounted with the front of the higher of the rim or counter surface 34" maximum above the finish floor or ground. Depth of lavatories or sinks shall not interfere with knee and toe clearance provided in accordance with CBC 11B-306 when forward approach is required CBC Sections 11B-606.3 and 11B606.7.
14. Water supply and drainpipes under accessible lavatories and sinks shall be insulated or otherwise configured to protect against contact. There shall be no sharp or abrasive surfaces under accessible lavatories or sinks. CBC Section 11B-606.5.

- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his

equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.

- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.
- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for sinks.
 - 2. Include rated capacities, operating characteristics, and furnished specialties and accessories.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:

- a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
- b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
- c. Include all pertinent construction, installation, performance, and technical data.
- d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.
 - 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the

Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.

5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For lavatories and faucets to include in operation and maintenance manuals.
 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Servicing and adjustments of automatic faucets.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blue-line prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducible tracings shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 CLASSROOM SINKS

- A. Utility Sinks: White enameled cast iron/Stainless steel, counter mounted:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Haws Manufacturing.
 - b. Just Manufacturing.
 - 2. Fixture:
 - a. Standard: ASME A112.19.3/CSA B45.4.
 - b. Type: Ledge back.
 - c. Number of Compartments: One.
 - d. Overall Dimensions: 25 by 17 inches.
 - e. Metal Thickness: 18-gauge.
 - f. Compartment: 16" x 14".
 - g. Dimensions: See Plumbing Fixture Schedule.
 - h. Drain: Grid with NPS 1-1/2 tailpiece with stopper
 - i. Drain Location: Centered in compartment.

2.2 SINKS

- A. Utility Sinks: Stainless-steel, counter mounted:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Just Manufacturing.

2. Fixture:

- a. Standard: ASME A112.19.3/CSA B45.4.
- b. Type: Ledge back.
- c. Number of Compartments: See Plumbing Fixture Schedule.
- d. Overall Dimensions: See Plumbing Fixture Schedule.
- e. Metal Thickness: 18-gauge.
- f. Compartment: See Plumbing Fixture Schedule.
- g. Dimensions: See Plumbing Fixture Schedule.
- h. Drain: Grid with NPS 1-1/2 tailpiece with stopper
- i. Drain Location: Centered in compartment.
- j. Faucet(s): See Plumbing Fixture Schedule
- k. Number Required: One.
- l. Mounting: On ledge.

2.3 SERVICE SINKS

A. Service Sinks - Enameled Cast Iron, Floor Mounted:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Commercial Enameling Company (CECO).
 - b. American Standard America.
 - c. Kohler Co.
- 2. Fixture:
 - a. Standard: ASME A112.19.1/CSA B45.2.
 - b. Style: With front apron and raised back.
 - c. Nominal Size: 28 by 28 inches.
 - d. Color: White.
 - e. Drain: Grid with NPS 3 outlet.
 - f. Rim Guard: Coated wire.
- 3. Faucet: Chicago Faucet "Manually Operated Sink Faucets".

2.4 HANDWASH SINKS

A. Handwash Sinks – Vitreous white china:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Standard.
 - b. Kohler.
- 2. Source Limitations: Obtain sinks from single source from single manufacturer.
- 3. Fixture:
 - a. Standards:

- 1) ASME A112.19.3/CSA B45.4.
- 2) NSF 61.
- b. Type: Wall-mounted vitreous china basin with radius corners, back for faucet, and support brackets.
- c. Overall Dimensions: 20-1/2" by 18-1/4" by 12-1/8 inches.
- d. Material: Vitreous china.
4. Faucet: Manually Operated Sink Faucets or Automatically Operated Sink Faucets.
5. Supply Fittings: Comply with requirements in "Supply Fittings" Article.
6. Waste Fittings: Comply with requirements in "Waste Fittings" Article.
7. Support: Zurn.
8. Mounting Height: Accessible in accordance with ICC A117.1.

2.5 MANUALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Manual Type: Single-control mixing, Single-control nonmixing, or Two-handle mixing:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 2. Standard: ASME A112.18.1/CSA B125.1.
 3. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punching's; coordinate outlet with spout and sink receptor.
 4. Body Type: Centerset of Single hole.
 5. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
 6. Finish: Chrome plated.
 7. Maximum Flow Rate: 1.5 gpm.
 8. Mounting Type: Deck, exposed.
 9. Valve Handle(s): Lever or 4-inch wrist blade.
 10. Spout Type: Swivel gooseneck.
 11. Vacuum Breaker: Required for hose outlet.
 12. Spout Outlet: Aerator or Laminar flow.
 - a. Style: Rigid.
 - b. Riser: 12-inch rigid riser.
 - c. Wall bracket.
- C. Commercial Service Sink Faucets - Manual Type:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Chicago Faucets.
2. Description: Wall/back mounted, brass body, with integral service stops, checks, spout with bucket/pail hook, 3/4-inch hose thread end, integral vacuum breaker, inlets 8 inches o.c., and two-handle mixing.
3. Faucet:
 - a. Standards:
 - 1) ASME A112.18.1/CSA B125.1.
 - 2) NSF 61 and NSF 372.
 - 3) ICC A117.1.
 - 4) ASSE 1001 (VB).
 - b. Finish: Polished chrome plated.
 - c. Handles: Lever.
 - d. Cartridges: One-fourth turn compression.
 - e. Brace: Adjustable top brace.

2.6 AUTOMATICALLY OPERATED SINK FAUCETS

- A. Sink faucets intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), with requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 and NSF 372, or be certified in compliance with NSF 61 and NSF 372 by an ANSI-accredited third-party certification body, in that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
- B. Commercial Sink Faucets - Automatic Type: Battery-powered, Hard-wired, electronic-sensor-operated, mixing, nonmixing:
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago Faucets.
 2. Standards: ASME A112.18.1/CSA B125.1 and UL 1951.
 3. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 4. General: Include hot- and cold-water indicators; coordinate faucet inlets with supplies and fixture hole punching's; coordinate outlet with spout and fixture receptor.
 5. Body Type: Centerset or Single hole.
 6. Body Material: Commercial, solid brass, or die-cast housing with brazed copper and brass waterway.
 7. Finish: Chrome plated.
 8. Maximum Flow Rate: 0.5 gpm.
 9. Mounting Type: Deck.
 10. Spout Type: Swivel, gooseneck.
 11. Spout Outlet: Aerator or Laminar flow.
 12. Control Module: Above deck water-resistant module with internal flow setting switches.
 13. Drain: Not part of faucet.

2.7 SUPPLY FITTINGS

- A. NSF Standard: Comply with NSF 61 and NSF 372 for supply-fitting materials that will be in contact with potable water.
- B. Standard: ASME A112.18.1/CSA B125.1.
- C. Supply Piping: Chrome-plated brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated brass or stainless-steel wall flange.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago.
- D. Supply Stops: Chrome-plated brass, one-quarter-turn, ball-type, or compression valve with inlet connection matching supply piping.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Chicago.
- E. Operation: **Loose key**.
- F. Risers:
 - 1. NPS 3/8.
 - 2. Chrome-plated, soft-copper flexible tube.

2.8 WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 1-1/2 offset and straight tailpiece.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. McGuire Manufacturing.
- C. Trap:
 - 1. Size: NPS 1-1/2.
 - 2. Standard or ADA with Protective Shroud Material:
 - a. Chrome-plated, two-piece, cast-brass trap, and swivel elbow with 0.032-inch-thick brass tube to wall; and chrome-plated, brass or steel wall flange.
 - 3. ADA Material:

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) McGuire Manufacturing.
- b. Pre-wrapped p-trap & trap arm with sleeve for tailpiece and supply covers; and chrome-plated, brass or steel wall flange.

2.9 SERVICE SINK WASTE FITTINGS

- A. Standard: ASME A112.18.2/CSA B125.2.
- B. Drain: Grid type with NPS 3 offset and straight tailpiece.
- C. Trap:
 - 1. Size: NPS 3.
 - 2. Material: Flat Chrome strainer, cast-brass trap, and swivel elbow.

2.10 SINK SUPPORTS

- A. Sink Carrier:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Zurn Industries, LLC; Plumbing Products Group.
 - b. Jay R. Smith Mfg. Co.
 - c. Watts; a division of Watts Water Technologies, Inc.
 - 2. Standard: ASME A112.6.1M.

2.11 GROUT

- A. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply piping and sanitary drainage and vent piping systems to verify actual locations of piping connections before sink installation.
- B. Examine walls, floors, and counters for suitable conditions where sinks will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.
- D. Closing-In of Uninspected Work: Do not allow or cause any of the work to be covered up or enclosed until it has been inspected, tested, and approved by the Architect. Any work enclosed or covered prior to such inspection and test shall be uncovered and, after it has been inspected, tested, and approved, make all repairs with such materials as may be necessary to restore all work, including that of other trades, to its original and proper condition.

3.2 INSTALLATION

- A. Install sinks level and plumb in accordance with rough-in drawings.
- B. Install supports, affixed to building substrate, for wall-hung sinks.
- C. Install wall-mounted sinks at accessible mounting height in accordance with ICC A117.1.
- D. Set floor-mounted sinks in leveling bed of cement grout.
- E. Install water-supply piping with stop on each supply to each sink faucet.
 - 1. Exception: Use ball or gate valves if supply stops are not specified with sink. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
 - 2. Install stops in locations where they can be easily reached for operation.
- F. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- G. Seal joints between sinks and counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."
- H. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible sinks. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

3.5 ADJUSTING

- A. Operate and adjust sinks and controls. Replace damaged and malfunctioning sinks, fittings, and controls.
- B. Install new batteries in battery-powered, electronic-sensor mechanisms.

3.6 CLEANING AND PROTECTION

- A. After completing installation of sinks, inspect and repair damaged finishes.
- B. Clean sinks, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.
- C. Provide protective covering for installed sinks and fittings.
- D. Do not allow use of sinks for temporary facilities unless approved in writing by Owner.

END OF SECTION 224216.16

SECTION 224713 - DRINKING FOUNTAINS

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. Drinking fountains.
 - 2. Bottle filling stations.
 - 3. Supports.

1.3 WORK INCLUDED

- A. Furnish all labor, materials, services, testing, transportation, and equipment necessary for the completion of all plumbing work as indicated on drawings and specified herein. Work materials and equipment not indicated or specified which is necessary for the complete and proper operation of the work of this Section in accordance with the true intent and meaning of the contract documents shall be provided and incorporated at no additional cost to the Owner.

1.4 QUALITY ASSURANCE

- A. Code Requirements: All work covered by this Section shall conform to the latest requirements of the following regulations:
 - 1. C.C.R., Title 24, Part 5 (2022 CPC).
 - 2. 2022 California Plumbing Code.
 - 3. SMACNA Seismic Restraint Manual Guidelines for Mechanical Systems.
 - 4. National Fire Protection Association.
 - 5. California Division of the State Architect.
 - 6. California State Division of Industrial Safety.
 - 7. County Health Department.
 - 8. Any other legally constituted body-having jurisdiction thereof.
 - 9. Access plumbing fixtures shall comply with all of the requirements of CBC Division 6.
 - 10. Heights and location of all fixtures shall be mounted according to CBC Sections 11B-602 through 11B-612.
- B. Nothing in the specifications or drawings shall be construed to permit deviation from the requirements of governing codes unless approval for said deviation has been obtained from the legally constituted authorities having jurisdiction and from the Owner's representative.

1.5 DRAWINGS

- A. Because of the small-scale drawings, it is not possible to indicate all offsets, fittings and accessories which may be required. The Contractor shall carefully investigate the conditions surrounding installation of his work, furnishing the necessary piping, fittings, valves, traps, and other devices which may be required to complete the installation.
- B. The general arrangement indicated on the drawings shall be followed as closely as possible. Coordinate with the Architectural, Structural, Mechanical and Electrical Drawings and the work of other trades prior to installation of piping fixtures and equipment to verify adequate space available for installation of the work shown. In the event a field condition arises which makes it impossible to install the work as indicated, submit, in writing, the proposed departures to the Architect for his approval. Only when Architect's approval is given, in writing, shall Contractor proceed with installation of the work.
- C. Special Note: Should the Contractor make changes in the installation differing from what is indicated on the contract drawings and not necessitated due to field conditions as indicated hereinabove, the Contractor shall be required to re-install the work to comply with what has been indicated on the contract drawings. Should it be impossible to re-install the work and the installation is in accordance with all governing authorities, the architect may permit the installation to remain. However, all costs incurred to revise the contract drawings by the engineer for resubmittal to the building department indicating the as-installed condition shall become the responsibility of the Contractor.
- D. In case of a difference in the specifications or between the specifications and the drawings, the Contractor shall figure the most expensive alternate and after award of contract, shall secure direction from the Architect.

1.6 PERMITS, INSPECTIONS AND LICENSES

- A. All permits, inspections and licenses required by the legally constituted authorities for installation of the work according to the plans and specifications shall be obtained and paid as a part of the work of this section.

1.7 PROTECTION

- A. All work, equipment and materials shall be protected at all times. Contractor shall make good all damage caused either directly or indirectly by his own workmen. Contractor shall also protect his own work from damage. He shall close all pipe openings with caps or plugs during installation. He shall protect all his equipment and materials against dirt, water, chemical and mechanical injury. Upon completion, all work shall be thoroughly cleaned and delivered in a new condition.
- B. Contractor shall be held responsible for all damage to equipment and materials until he has received written notice from the Architect or Engineer that his work has been accepted.

1.8 LOCATIONS

- A. The locations of apparatus, piping and equipment indicated on the drawings are approximate. Piping and equipment shall be installed in such a manner as to avoid all obstruction, preserve headroom, and keep openings and passages clear. The locations of and mounting heights of all fixtures shall be coordinated with the architectural plans and room elevations.

- B. Clearances and Openings: Contractor shall cooperate and coordinate his work with all other trades to avoid conflict and permit for a neat and orderly appearance of the entire installation. The Contractor shall, in advance of the work, furnish instructions to the General Contractor as to his requirements for equipment and material installation of any kind, whether or not specifically mentioned on drawings or in the specifications, and shall include recesses, chases in walls, and all required openings in the structure. Should furnishing this information be neglected, delayed or incorrect and additional cuttings are found to be required, the cost of the same shall be charged to this Contractor.
- C. Contractor shall verify and coordinate pipe routing with location of all electrical rooms, elevator equipment rooms, telecom/data rooms, and other rooms dedicated to the housing of switchgear, panels, or other electrical equipment. In no case shall piping be installed within or above the ceiling of such rooms.

1.9 ACTION SUBMITTALS

- A. Product Data: For each type of drinking fountain and bottle filling station.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
 - 2. Include operating characteristics, and furnished specialties and accessories.
- B. Shop Drawings:
 - 1. Include diagrams for power wiring.

1.10 SUBMITTAL DATA

- A. Submittal Requirements:
 - 1. Furnish, all at one time, prior to any installation, within the time noted below, one (1) digital (PDF) copy of valid submittal data on all fixtures, material, equipment, and devices. Each submitted item shall be indexed and referenced to these specifications (1 pdf submittal for each specification section) and to identification numbers on fixtures and equipment schedules.
 - 2. Manufacturers' submittal literature and shop drawings are required on all items to ensure the latest and most complete manufacturer's data is available for review. Requirements of the submittals and Engineer's submittal notes are a part of the work of this Division except that Engineer's notes may not be used as a means of increasing the scope of work of this Division.
 - 3. Submittals will be checked for general conformance with the design concept of the project, but the review does not guarantee quantities shown and does not supersede requirements of this Division to properly install work.
 - 4. To be valid, all submittals must:
 - a. Be delivered to the Architect's office within thirty-five (35) days of award of the contract. Contractor shall make time allowance for Engineer's review, return of comments, if any, and resubmittal if required. Corrections or changes in submittals returned as inadequate or incomplete shall be accomplished within this time limit.
 - b. Clearly indicate and label as such any items proposed as substitution for that specified or shown on plans.
 - c. Include all pertinent construction, installation, performance, and technical data.
 - d. Have all product data sheets clearly labeled to indicate the individual items being submitted. In addition, all required options and accessories shall be clearly marked.

- 1) Product data sheets corresponding to items indicated on plans shall be clearly labeled with the corresponding fixture or equipment tag number.
 - 2) Product data sheets corresponding to items indicated in specifications shall be clearly labeled with the specification section, page, and item numbers.
- e. Include, for every item which differs in size, configuration, connections, service, accessibility or any other significant way, a drawing to the same (or larger) scale as to the pertinent portions of the contract drawings. In this drawing show a complete layout of the system except that which is identical to the contract drawings unless the unchanged portions must be shown to indicate such things as clearances. This drawing, together with the contract design drawings must show the complete system as revised to accommodate the proposed alternative.

B. Substitution Requirements:

1. Any items included in submittals and proposed by the Contractor as substitution for that specified or shown on plans shall be submitted within thirty-five (35) days of award of the contract. After such time, proposed substitutions shall not be accepted for review, and the Contractor shall submit all items as specified or shown on plans.
 - a. For each item proposed as substitution for that specified or shown on plans, copies of product data sheets for the specified item shall be placed side by side with product data sheets for the proposed substitution item within the submittal.
 - 1) In addition to the Submittal Requirements for labeling listed above, product data sheets for the specified item shall be clearly labeled "SPECIFIED ITEM, NOT SUBMITTED". Product data sheets for the corresponding proposed substitution item shall be clearly labeled "PROPOSED SUBSTITUTION".
 - b. Provide calculations and other detailed data justifying how any items proposed as substitution were selected for proposal. Data must be complete enough to permit detailed comparison of every significant characteristic for which the specified item was analyzed during design.
2. It shall be the Contractor's responsibility to provide sufficient information to allow the Engineer to analyze any proposed alternate. If inadequate information is provided, the proposal will not be approved, and resubmittal will not be allowed.
3. The Contractor shall provide or perform tests required by Engineer for purpose of judging acceptability of proposed substitutions.
4. The Contractor assumes full responsibility that alternate items and procedures will meet the job requirements and is responsible for cost of redesign and of modifications to this and other parts of work caused by alternate items furnished under work in this Section. In view of these responsibilities, it is the purpose of these specifications to establish procedures to ensure that the Contractor has considered all the ramifications of proposed alternates before submitting them for review. Submittals which do not comply with the requirements of these specifications, or which indicate proposed alternates that were selected without proper regard to the requirements of the job will not be approved. No more than one proposed alternate will be considered for each item.
5. Alternate items installed without Engineer's approval will be replaced with specified items at Contractor's expense.
6. The Architect or his authorized representative shall be the sole judge as to the quality and suitability of proposed alternate equipment, fixtures, or materials. Decisions of the Architect or that of his representative shall be final and conclusive.

1.11 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For drinking fountains and bottle filling stations to include in maintenance manuals.

1.12 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filter Cartridges: Equal to 10 percent of quantity installed for each type and size indicated, but no fewer than 2 of each.

1.13 UNINSPECTED WORK

- A. The Contractor shall not allow or cause any of his work to be covered up or closed in until it has been inspected, tested, approved by all authorities have jurisdiction, and until Project Record drawings have been properly annotated.
- B. Should any of his work be covered up or closed in before such inspection, he shall, at his own expense, uncover the work to the satisfaction of the inspection party. All related repair work cost shall be borne by the Contractor.

1.14 RECORD DRAWINGS

- A. Contractor shall provide and keep up to date a complete "as-built" record set of blueline prints which shall show every change from the original drawings and the exact "as-built" locations and sizes of the work provided under this Section of the specifications. This set shall include locations, dimensions, depth of buried piping, cleanouts, shut-off valves, sewer invert locations, plugged wyes, tees, etc. On completion of the work, the Contractor shall incorporate all as-built information on a set of reproducible tracings provided by the Architect and this set of reproducibles shall be delivered to the Architect.

1.15 GUARANTEES

- A. Contractor shall guarantee the entire plumbing and piping systems unconditionally for a period of one (1) year after final acceptance. If, during this period, any materials, equipment, or any part of the systems fail to function properly, the Contractor shall make good the defects promptly and without any expense to the Owner.
- B. Contractor shall be responsible for all damage to any part of the premises caused by leaks in pipelines or equipment furnished and installed under this Section for a period of one (1) year after date of acceptance of his work.
- C. All equipment and fixtures shall carry manufacturer's warranty against defective parts or poor workmanship for not less than one (1) year. See specific equipment specifications for extended warranty requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Standards:

1. Drinking fountains and bottle filling stations intended to convey or dispense water for human consumption are to comply with the U.S. Safe Drinking Water Act (SDWA), requirements of the Authority Having Jurisdiction (AHJ), and with NSF 61 or NSF 372, or be certified in compliance with NSF 61 or NSF 372 by an ANSI-accredited third-party certification body, that the weighted average lead content at wetted surfaces is less than or equal to 0.25 percent.
2. Comply with ASME A112.19.3/CSA B45.4 for stainless steel drinking fountains and bottle filling stations.
3. Comply with NSF 42 and NSF 53 for water filters for drinking fountains and bottle filling stations.
4. Comply with ICC A117.1 for accessible drinking fountains and bottle filling stations.

2.2 DRINKING FOUNTAINS

A. Drinking Fountains - Surface Wall-Mounted, Stainless Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Haws Corporation.
2. Source Limitations: Obtain surface wall-mounted, stainless steel drinking fountains from single source from single manufacturer.
3. Type: Vandal resistant.
4. Receptor(s):
 - a. Type: See Plumbing Fixture Schedule.
 - b. Shape: See Plumbing Fixture Schedule.
 - c. Back Panel: Stainless-steel wall plate behind drinking fountain.
 - d. Drain: Grid type with NPS 1-1/4 tailpiece.
5. Control: Push button.
6. Bottle Filler: Push-button activation.
7. Supply: NPS 1/2 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 chrome-plated brass P-trap and waste.
9. Filter: One or more water filters with capacity sized for unit peak flow rate.
10. Support: Provide manufacturer's mounting plate **and** drinking fountain carrier.
11. Drinking Fountain Mounting Height: High/low - standard/accessible in accordance with ICC A117.1.

2.3 BOTTLE FILLING STATIONS

A. Bottle Filling Station - Surface Wall-Mounted, Stainless-Steel:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Elkay Manufacturing Co.
 - b. Haws Corporation.
2. Source Limitations: Obtain surface wall-mounted, stainless steel, bottle filling stations from single source from single manufacturer.
3. Type: Vandal resistant.
4. Cabinet: Stainless-steel.
5. Bottle Filler: Push-button activation.
6. Drain: Grid type with NPS 1-1/4 tailpiece.
7. Supply: NPS 1/2 with shutoff valve.
8. Waste Fitting: ASME A112.18.2/CSA B125.2, NPS 1-1/4 brass P-trap.
9. Filter: One or more water filters complying with NSF 42 and NSF 53 and with capacity sized for peak flow rate.
10. Support: Provide manufacturer's mounting plate and drinking fountain carrier.
11. Bottle Filling Station Mounting Height: Accessible in accordance with ICC A117.1.

2.4 SUPPORTS

A. Drinking Fountain Carrier:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Elkay Manufacturing Co.
 - b. Haws Corporation.
2. Standard: ASME A112.6.1M.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for water-supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.
- B. Examine walls and floors for suitable conditions where fixtures will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install fixtures level and plumb according to roughing-in drawings. For fixtures indicated for children, install at height required by authorities having jurisdiction.
- B. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.

- C. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball or gate valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.
- E. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding fittings. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."
- F. Seal joints between fixtures and walls using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

3.3 PIPING CONNECTIONS

- A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.
- B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."
- C. Install ball or gate shutoff valve on water supply to each fixture. Install valve upstream from filter for drinking fountain. Comply with valve requirements specified in Section 220523 "General-Duty Valves for Plumbing Piping."
- D. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

3.4 ADJUSTING

- A. Adjust fixture flow regulators for proper flow and stream height.

3.5 CLEANING

- A. After installing fixtures, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.
- B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.
- C. Provide protective covering for installed fixtures.
- D. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224713

SECTION 23 00 00 – BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 apply to this Section. Where conflicts occur between Divisions and Sections, the more stringent requirements shall apply.
- B. The requirements of this section apply to all Work in Division 23.
- C. Summary: This section includes the following:
 - 1. General definitions
 - 2. Regulations, codes, permits, and fees.
 - 3. General requirements
 - 4. Pre-Installation meetings
 - 5. Quality Assurance
 - 6. Testing
 - 7. Warranty
 - 8. Contract Drawings
 - 9. Submittal Procedures
 - 10. Project Record Documents
 - 11. Closeout Submittals
 - 12. Coordination
 - 13. Temporary facilities
 - 14. Local and existing conditions
 - 15. Hoist, rigging, transportation, and scaffolding.
 - 16. Protection, delivery, storage and handling
 - 17. Startup and field adjustment
 - 18. Cleanliness
 - 19. Review of construction
 - 20. Final inspection
 - 21. Project Close-out.
- D. Related Sections
 - 1. All sections within Division 01 – General Requirements
 - 2. Relevant sections within Division 03 – Concrete
 - 3. Relevant sections within Division 05 – Metals
 - 4. Relevant sections within Division 07 – Thermal and Moisture Protection
 - 5. Relevant sections within Division 08 – Openings
 - 6. Relevant sections within Division 09 – Finishes
 - 7. Relevant sections within Division 21 – Fire Suppression
 - 8. Relevant sections within Division 22 – Plumbing
 - 9. All sections within Division 23 – Heating, Ventilation, and Air Conditioning
 - 10. Relevant sections within Division 26 – Electrical

1.2 GENERAL DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.
- F. “Regulating Authorities” means all governmental, utility and fire protection authorities having jurisdiction.
- G. “Provide” means to supply, erect, install and connect up completely, in readiness for regular operation, the particular work referred to.
- H. “Furnish” means purchase, store and deliver the specified material, equipment or other item to the person or party indicated.
- I. “Approved Equal” means any equipment or material which in the opinion of the approving party, is equal in quality, durability, appearance, strength, design and performance to the equipment or material specified and will function adequately in accordance with the general design.
- J. “Singular Number”: Where any device is herein referred to in the singular number, such reference shall be deemed to apply as many such devices as are required to complete the installation or as many as are shown.
- K. “Piping” as used in the drawings and specifications means all pipe, fittings, nipples, flanges, valves, unions, hangers and supports that are required for a complete functional system.
- L. “Ductwork” as used in the drawings and specifications means all ductwork, fittings, dampers, air terminal devices, diffusers, registers, grilles, hangers and supports that are required for a complete functional system.
- M. “Wiring” includes, in addition to conductors, all raceways, conduit, fittings, boxes, switches, hangers and other accessories related to such wiring.
- N. “Contract Documents” or “Documents” shall mean the latest version of all drawings and specifications prepared by the Engineer and Architect.
- O. “Authority Having Jurisdiction” or “AHJ” shall mean the building department, fire department, inspectorate or other authority having legal jurisdiction relevant to the specific work being described in the City or State where the project is located.

1.3 REGULATIONS, CODES, PERMITS, AND FEES

- A. It is not the intent of drawings and specifications to repeat requirements of codes except where necessary for completeness or clarity.
- B. Conform to all rules, regulations, laws, and ordinances governing the area in which this construction occurs. Rulings and interpretations of authorities shall be considered a part of the regulations. All work and material shall be in full accordance with the latest rules and regulations of the following agencies:
 - 1. California Specific Requirements:
 - a. California Code of Regulations (CCR)
 - b. California Building Code (CBC)
 - c. California Energy Code (CEC)
 - d. California Fire Code (CFC)
 - e. California Mechanical Code (CMC)
 - f. California Plumbing Code (CPC)
 - g. All local and city amendments to codes.
 - h. California State Fire Marshall and the California State Department of Public Health, Titles 17 and 22.
 - i. California Code of Regulations Titles 8, 19 and 24 and other applicable laws or regulations.
 - j. Comply with the Safety Orders issued by California Occupational Safety and Health Act (Cal-OSHA) and all other safety, health or environmental regulations of the State of California and any cities and districts having jurisdictional authority. Where an omission or conflict appears between Cal-OSHA requirements and the drawings and specifications, Cal-OSHA requirements shall take precedence.
 - k. National Electric Code (NEC)
 - 2. American Gas Association
 - 3. American Air Moving and Conditioning Association (AMCA)
 - 4. American National Standard Institute (ANSI)
 - 5. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE)
 - 6. American Society of Mechanical Engineers (ASME)
 - 7. American Society for Testing and Materials (ASTM)
 - 8. American Water Works Association (AWWA)
 - 9. Environmental Protection Agency (EPA)
 - 10. National Electrical Manufacturer's Association (NEMA)
 - 11. National Fire Protection Association (NFPA)
 - 12. Occupational Safety and Health Administration (OSHA)
 - 13. Safety Orders of the Division of Industrial Industry
 - 14. Sheet Metal and Air Conditioning Contractor's National Association (SMACNA)
 - 15. South Coast Air Quality Management District
 - 16. Underwriters Laboratory, Inc. (UL)
- C. Nothing in the drawings or specifications is to be construed to permit work not conforming to these codes and regulations. Should there be any direct conflict between the above rules and the specifications, the rules shall govern. Where the standards of the drawings and specifications for materials and/or workmanship are higher than the requirements of the

documents cited above, the drawings and specifications shall take precedence; otherwise the documents shall govern.

- D. Any appliance for which there is an energy efficiency standard established by the authority having jurisdiction shall comply with the applicable standard.
 - E. Include in work, without extra cost to Owner, labor, materials, services, apparatus, and drawings (in addition to contract drawings and documents) required to comply with applicable laws, ordinances, rules and regulations. Charges for all materials and labor required for compliance with these rules and regulations shall be included in the bid price.
 - F. Give necessary notices, obtain permits, and pay taxes, fees and other costs in connection with work. File necessary plans, prepare documents, and obtain necessary approvals of regulating authorities having jurisdiction. Obtain all required certificates of inspections, permits, and approvals and deliver to Owner before request for acceptance and final payment for Work.
 - G. Provide Owner and local inspector access to work at all time. The Contractor shall coordinate all inspections and provide all support and personnel necessary for successful completion. Make corrections in the work as required by the Owner or Inspector to pass local regulations. Contractor shall be responsible for all law violations caused by the work under this division. Notify the Owner in writing when a discrepancy occurs between code requirements and work shown on drawings and resolve matter before proceeding with work.
 - H. Permit
 - 1. Obtain the required permits from the local authorities for this work and pay all fees required by the local, state, and federal authorities for permits, inspection, and review, including special agency construction and operating permits. Make corrections in the work as required by the owner's representative or inspector to pass local regulations.
 - 2. Make application and pay for all certificates of inspection, taxes and permits required by local, state or federal governments, public utilities, or other authorities having jurisdiction. Deliver to the owner's representative any and all certificates of inspections, permits, and approvals which may be required by such authorities.
 - 3. DSA Approval: It shall be the contractor's responsibility to obtain DSA approval for the installation of all equipment not already approved by DSA in the contract documents. This includes any substitutions to equipment without prior approval. The contractor shall submit all documents through the owner's representative for DSA approval.
 - I. Include all utility and local building department charges for providing temporary and permanent power, water, sewer, and gas services to the buildings.
- 1.4 GENERAL REQUIREMENTS
- A. Contractor's responsibilities include:
 - 1. Field coordination between trades.
 - a. Coordinate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the drawings and specifications to determine nature and extent of work specified in

other Divisions which adjoins or attaches to the work of this Division. Confer with other Divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated, and that maximum head room and clearance may be obtained. In the event that interference develop, the owner's representative's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit or equipment to clear such interferences.

2. Submittals of shop drawings and product data per procedure in Division 1
 3. Provide Operation and Maintenance Manuals
 4. Provide record documents
 5. Install of system including equipment, piping and ductwork and associated controls
 6. Satisfy seismic anchorage requirements for equipment, piping and ductwork installation
 7. Testing and Balance of air and water system
 8. Provide equipment and system identification
 9. Provide complete DDC controls to deliver complete and functional system.
- B. Provide a complete mechanical system in full working order without objectionable noise or vibration. The documents do not undertake to show or list every item to be provided. The Contractor shall examine the Documents at the time of the bid and notify the Architect/Engineer in writing of any and all discrepancies. When an item not shown or listed is necessary for the proper operation of equipment which is shown or listed, provide an item which will allow the system to function properly at no increase in Contract Sum. Should there be any direct conflict in the specifications and drawings, an RFI shall be submitted with the Contractor's suggestion for resolution.
1. Provide, design, calculation, coordinate, and installation of the following items specified under specified performance criteria:
 - a. Support and anchorage of all equipment, valving, piping, duct work, duct silencers and controls equipment and conduit. Refer to Section 230529.
 - b. Thermal and seismic expansion. Refer to Section 230516.
 - c. Vibration isolation and seismic anchorage. Refer to Section 230548.
 2. The Contractor shall perform a calculation to determine actual pressure loss on each ductwork and pipework system. System pressure drop calculations shall be submitted. If the available pressure from the scheduled fan or pump is not sufficient, the Contractor shall notify the Owner immediately. No fan, air handler or pump equipment submissions shall be submitted for review prior to the completion of these calculations. If items are submitted prior to the receipt of the calculations, they must be accompanied by a letter from the Contractor bearing the risk and cost of any future change necessary to achieve the system's performance. This letter does not exempt the Contractor from having to submit the calculations.
 3. Provide and install complete direct digital control system, including devices, controllers, and sensors.
 - a. Controls programming, architecture, and conduit sizing and routing. Refer to Section 230900.
 - b. Provide all control devices for mechanical equipment and systems in conjunction with control system requirements, including coordination with Division 26 for electrical connection for complete, tested and operational systems.

4. Provide testing, adjusting and balancing for all systems. Refer to Section 230593.
5. Provide commissioning data collection and testing services for pre-functional checklists and functional tests.
6. Furnish and install the following:
 - a. Provide rooftop packaged units which will be ARI certified with capacity in the schedule and shall use environmentally preferable refrigerant.
 - b. Provide outdoor installed boiler plant with associated pumps, piping, and controls to satisfy building heating requirements.
 - c. Provide fan coil units, VAV with reheating coils, supply fan and exhaust fan
 - d. Provide laboratory control valves for fume hood exhaust, general exhaust, and supply valve with reheating coils.
 - e. Provide air distribution devices to complete the HVAC supply, outside air, return, relief, and exhaust systems.
 - f. Provide complete building automation system for all air and hydronic systems to match district and campus standard.
 - g. Provide all seismic bracing and isolation necessary for HVAC equipment, pipes and ducts.
- C. All materials installed shall be new and free of defect. They shall be shipped and stored on site sealed in plastic wrap so as to prevent the entry of construction dust. All ductwork shall be protected, wiped down and installed as consistent with the SMACNA Cleanliness Class C-Advance, per the SMACNA Duct Cleanliness for New Construction Guidelines. All installed ductwork and piping shall have its open ends sealed at the end of each day. All installed ductwork shall retain its cap or seal until immediately before an additional extension is to be added. Prior to an extension being added, the existing duct shall be inspected for internal cleanliness and wiped down as necessary within 5 feet of the seal to return the duct interior to the dust-free state it had when originally installed with wiped-down interiors as required under the SMACNA standard.
- D. All equipment shall be installed per the manufacturer's recommendations, with the manufacturer's representatives present at initial startup. Contractor shall provide all fittings, transitions, dampers, valves, and other devices required for a complete workable installation. Manufacturer's installation instruction shall be made available to the inspecting authorities.
- E. All equipment regulated by the California Energy Code with regards to energy efficiency shall show proof of compliance, and all devices requiring a UL listing shall have a certificate. All motors shall be premium efficiency and be sized for three phase power if horsepower is greater than or equal to 3/4 HP. All fuel burning devices shall show proof of compliance with current South Coast Air Quality Management District rulings.
- F. All design of vibration isolation and seismic anchorage shall be provided by licensed professional structural engineers registered in State of California (SE) under the contractor's scope after the final selection of equipment and final shop drawing layout is complete. This is to ensure that the seismic anchorage matches the unique characteristics of the specific manufacturer and model number from the accepted submittal.
- G. All design of piping support and seismic or thermal expansion shall be provided by a licensed professional engineer in the State of California under the contractor's scope after the final piping shop drawing layout is complete.
- H. Pipe Sleeves

1. Sleeves through cast concrete footings, exterior walls, exterior concrete floors, and penetrations of potentially wetted floors of mechanical rooms shall be schedule 40 galvanized steel pipe. Sleeves through internal constructions may be galvanized sheet metal. Plastic sleeves are not allowed. See 230529 for more details.
 2. Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where pipes are insulated, make sleeves of sufficient diameter to pass pipe insulation.
 3. Sleeves in underground walls shall be at least 1-1/2" larger than outside diameter of pipe, and space between sleeve and pipe shall be sealed on both sides of the wall. The seal shall be guaranteed vapor-tight and watertight using products similar to Link-Seal.
 4. Sleeve made of steel pipe to have minimum 7/32" minimum thickness.
 5. Sleeves passing through floors in occupied zones shall project a minimum 1-inch above slab and be sealed watertight.
 6. Sleeves passing through mechanical room floors shall extend a minimum 4-inch and have proper flashing.
- I. Commissioning will be a part of the project and the responsibility of the General Contractor under the oversight of the owner's commissioning agent. The commissioning of this project shall comply with CHPS (Collaborative for High Performance School) commissioning credit requirements (EE3.0 – Commissioning and EE3.1 – Additional Commissioning Qualifications). All startup testing, pre-functional testing, and performance testing shall be included in the scope of the Division 23, testing adjusting and balancing, and controls subcontractors. These parties shall fully cooperate with the Commissioning Agent in the completion of this work.
- J. Defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the owner's representative, and the work shall be re-executed by the contractor at no cost to the owner.
- K. CHPS certification is required for this project. See Division 1 specification section(s) for Sustainable Design Requirements and project requirements associated with the work of this Division.
- 1.5 QUALITY ASSURANCE
- A. Install Work by craftsmen skilled in the trade involved and by apprentices as indicated in the General Conditions. All work shall be performed by properly licensed plumbers, mechanics, and technicians with work limited to their respective trades.
- B. Supply all equipment and accessories in compliance with all applicable national, state and local codes.
- C. Perform work in manner precluding unnecessary fire hazard.
- D. Equipment in the following categories shall be of one manufacturer or available through one manufacturer for each category to facilitate ease of maintenance for the Owner
1. Rooftop Package Units
 2. Boilers
 3. Pumps
 4. Laboratory Air Valves (supply, general exhaust and fume hood exhaust valves)

5. Fans including general exhaust fan, kitchen exhaust fan, and laboratory exhaust fans
6. Fan Coil Units
7. CAV/ VAV Air Terminal Units
8. Motors
9. Starters and Variable Frequency Drives
10. Temperature Controls
11. Thermometers
12. Pressure Gauges
13. Valves (by Type)
14. Dielectric Unions
15. Strainers
16. Air Filters
17. Dampers
18. Actuators
19. Air Separators
20. Chemical Pot Feeders
21. Chemical Water Treatment
22. Expansion Tanks
23. Diffusers

E. Specific Requirements

1. All equipment and accessories shall be the product of a manufacturer regularly engaged in its manufacture.
2. All items of a given type shall be the product of the same manufacturer.
3. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code-Steel."
4. All Base Materials: Comply with standard ASTM and ANSI.
5. All Pressure Vessels, Relief Valves, Safety Relief Valves and Safety Valves: Comply with standards, ASME stamped.
6. All Electrical Devices and Wiring: Conform to standards of NEC. All devices: UL listed and identified.
7. Materials and adhesives used throughout the mechanical systems for insulation, filters, ducts, flexible connections and jackets or coverings regardless of kind for piping and ducting system components, shall have a flame spread rating not over 25 without evidence of continued combustion and with a smoke developed rating not higher than 50. "Flame Spread Rating" and "Smoke Developed Rating" shall be as determined by the "method of test of surface burning characteristics of building materials, NFPA No. 244, ASTM E84, Underwriters Laboratories, Inc., Standard". Such materials are listed in the Underwriters Laboratories, Inc., "Building Materials List" under the heading "Hazard Classification (Fire)".
8. Equipment shall be approved for use by all relevant Authorities Having Jurisdiction, where applicable.
9. Equipment required to have test labels by requirements of individual equipment sections shall have labels permanently affixed.
10. Manufacturer's nameplate, name or trademark shall be permanently affixed to all equipment and material furnished under this Specification. The nameplate of the Subcontractor or Distributor is not acceptable.

F. Equipment Installation

1. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
2. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
3. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
4. Install equipment to allow right of way for piping installed at required slope.
5. Assemble equipment which is required to be field assembled under the direct supervision of the manufacturer's agent. Prior to the final acceptance submit letters from the manufacturers that this has been done.
6. Accurately set and level with supports neatly placed and properly fastened. Properly fasten equipment in place with bolts to prevent movement in earthquake. No allowance of any kind will be made for negligence on part of Contractor to foresee means of bringing in, installing equipment into position inside building.

G. Manufacturer's Checking:

1. All equipment shall be installed in accordance with the recommendation of the manufacturer. Use printed descriptions, specifications and recommendations of manufacturers as a guide for installation of Work. During construction, request supervisory assistance from equipment manufacturer's representatives so the equipment will be correctly installed. After installation, request the Owner to inspect and see the equipment is in proper working order.
2. Manufacturer's representative shall review the overall system design relative to the proper application of his equipment in the particular system. He shall note conduit, wiring, control, location, and other relevant relationships, and furnish accessories necessary for satisfactory operation.
3. Before equipment start up, the manufacturer's representative shall submit to the Owner, a signed statement certifying to their inspection and noting that the equipment is properly installed and ready for operation.

H. Factory and Field Testing

1. See each Section for the required testing and procedures.
2. Provide the services of a qualified testing laboratory/agency to perform the specified field tests.
3. Notify the Owner at least 72 hours in advance of tests.
4. Provide all materials required for testing.
5. Test reports shall include: description of equipment tested, description of test procedures, test results, names and signatures of witnesses of tests.

I. Materials and Workmanship

1. Materials shall be new, meet detailed requirements of the contract document and the identifiable as being specified or substitute products. In no case shall a Bidder base his bid on a class of material or workmanship less than that required by the contract documents and the governing codes and ordinances.
2. Materials that do not conform to the requirements of the contract documents, are not equal to approved samples or are unsatisfactory or unsuited to the purpose for which they are intended, will be rejected and shall not be installed.

3. Defective work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or other cause shall be removed within ten (10) days after written notice is given by the Owner, and the work shall be re-executed by the Contractor. The fact that the Owner may have previously overlooked such defective work shall not constitute acceptance of it.
4. All work shall be performed in the best and most workmanlike manner by people skilled in their respective trades and properly licensed.

1.6 TESTING

- A. See section 230593 for the requirements of the testing, adjusting, and balancing procedures required to be performed prior to final acceptance.
- B. Provide the services of a qualified test laboratory / agency to perform the specified filed tests. Notify the owner's representative minimum 24 hours in advance of performance of work requiring testing. Provide all materials, manpower, and tools for testing.
- C. Upon completion of the work and following adjustment of all equipment, conduct an operating test for each system's acceptance. Demonstrate all systems and equipment to be operational and free from all electrical and mechanical defects.
- D. Notify the Owner fourteen days in advance of when tests will be performed. At that time, provide a test procedure plan, test schedule and test procedure forms. Test shall be performed to the satisfaction of the Owner and regulating authority having jurisdiction. Submit written certificates that tests have been performed in accordance with Specification requirements.
- E. Labor, materials, instruments and power required for testing provided under respective sections for work under that Section. Test all systems as specified under various applicable section. Duration of tests shall be determined by the authority having jurisdiction and in no case less than the time specified.
- F. Repair or replace defective Work and repeat tests until particular systems and component parts thereof, receive approval of Owner and regulating authority. Any damages resulting from tests shall be repaired and damaged material replaced, to the satisfaction of Owner and at no cost to Owner.
- G. Tests shall be performed on individual equipment, systems, and their controls. Whenever the equipment or system under test is inter-related with, and depends upon, the operation of other equipment or systems and their controls for proper operation, functioning, and performance, the latter shall be operating simultaneously with equipment or system being tested.
- H. Pressure test piping before connection to equipment as required under Sections 232113. No piping equipment or accessories shall be subjected to pressures exceeding their rating. No piping shall be closed up, furred in, or covered before testing. Notify regulating authority and Owner with advanced notice.
- I. Drain water used for pressure testing from the system after tests are complete. Repair or replace any damage caused by water left in system at no expense to the Owner.
- J. Equipment and systems which normally operate during certain seasons of year shall be tested during the appropriate season.

- K. After completion of testing and adjustment, operate the different systems and equipment under normal working conditions for 72 hours continuously and show specified performance. If, in the opinion of the Owner, performance of equipment or systems is not in accordance with specifications or submitted data, alter or replace equipment at no increase in Contract Sum. Contractor, at his opinion, may order tests from an independent approved laboratory to prove compliance. All such tests shall be at no increase in Contract Sum. Repeat testing process until the system passes the intent of the test.
- L. At completion of Work, provide written certification that all systems are functioning properly without defects.
- M. Test report shall include
 - 1. Description of equipment tested.
 - 2. Description of test procedures.
 - 3. Test results
 - 4. Names and signatures of witnesses of tests.

1.7 WARRANTY

- A. Conform to the requirements of Division 1- Execution and Close Out Procedures and Warranties
- B. Unless otherwise noted within a particular section, under special warranty each complete system shall be warranted by the Contractor for the period referenced in Division 1. Each system shall be free of defects of materials and workmanship and shall perform satisfactory under all conditions of load or service. The warranties shall provide that all additional controls, protective devices or equipment provided as necessary to make the system or equipment operate satisfactorily and that any faulty materials or workmanship shall be replaced or repaired. On failure of the warrantor to do the above after written notice from Owner, the Owner shall have the work done at the cost of the warrantor. Loss of refrigerant is considered a defect in workmanship and/or equipment, to be corrected at no extra cost to the Owner.
- C. Provide new materials, equipment, apparatus and labor to replace that determined by Owner to be defective or faulty within the warranty period.
- D. This guarantee also applies to services including Instructions, Testing, Adjusting, Balancing, Noise, and Commissioning.
- E. Furnish Manufacturers' standard Warranties in excess of the period referenced in Division 1 only as specifically required under the individual equipment section.
- F. Unless otherwise noted, warranties shall commence upon the Owner's final acceptance of the project.

1.8 DRAWINGS

- A. General Information Regarding Drawings:
 - 1. The drawings show the general arrangement of all piping, ductwork, conduit and equipment. Examine drawings and specifications carefully, and notify the Owner by

- letter or Request for Information (RFI) of any discrepancies so these can be rectified at an early date.
2. Should conditions necessitate any rearrangements, the Contractor shall prepare and submit drawings showing the changes before proceeding with the work. If such changes are approved, they shall become a part of this contract after their approval.
 3. Due to the small scale of the drawings, it is not possible to show all offsets and every detail of construction. Additional fittings, valves, traps, transitions, ducts, etc., shall be furnished and installed at no extra cost to the Owner. It is not the intent of drawings and Specifications to repeat requirements of codes except where necessary for completeness or clarity.
 4. The drawings are diagrammatic and are a graphic representation of the Contract Requirements, and are intended to convey scope of work. Dimensions of work as indicated on plans are not guaranteed to be as-built dimensions. No measurements shall be scaled from the drawings for use as a definite dimension for layout or fitting work in place. All items not labeled with dimensions are approximate only. The Contractor is solely responsible for dimensional control and coordination of the work to be installed.
 5. The layout of equipment, as shown on the plans, shall be checked and exact location determined by dimensions of equipment accepted for installation. Consult the Architectural and Structural Drawings for all dimensions, locations of partitions, sizes of structural members, foundations, etc. Exact locations necessary to secure best conditions shall be determined in field coordination and shall be approved by the Owner prior to installation. In addition, the Owner reserves right at no increase in contract sum to make any reasonable change in location of mechanical items exposed at ceilings or on walls to group them in an orderly relationship or increase utility and access if the Owner's request is made prior to installation.
 6. The Contractor shall be responsible for the coordination of the mechanical ducting and piping distribution with the fire sprinklers, lighting, conduit, cable tray, structural members, ceiling support and all other trades present within the project.

B. General Information Regarding Electronic Drawings:

1. At the Owner's direction, electronic files of the documents may be available to the Contractors subject to the following caveats:
 - a. Provision of electronic files does not release the Contractor from the requirements of the Contract Documents regarding coordination, submittals or any other issues outlined in the Contract Documents.
 - b. The official Contract Documents are the hard copy versions, not the electronic files.
 - c. The Contractor is responsible for all information extracted or inferred from the electronic files.
 - d. Submission of the electronic file unchanged as a shop drawing will be rejected without review.
 - e. These documents are provided only as a convenience to the Contractor. The Architect/Engineer is under no obligation to provide updated drawings during the Construction Phase or to track changes arising from RFIs, change orders, substitution requests, or submittal-generated alterations.
2. Where three-dimensional (3D) files are provided as a portion of the construction documents, these files are used to represent the designer's intent to show a viable solution with regard to the elevations, sizes, and routing of the mechanical system around the structural obstacles and other trades known at the time of design.

Although the piping, conduit, control panels, support, or construction of other trades maybe shown for reference in certain locations in order to generate two-dimensional (2D) sections, the placement of these items in the 3D model are as an allowance for reference only, and they are located on an as-needed basis for the purposes of demonstrating a solution for coordination in an area known to be particularly congested. The presence of this information does not imply that complete coordination has occurred, as there are many trades that are design-build with regard to placement. The presence of this information does not absolve the Contractor of responsibility for field coordination with all trades. The lack of multi-trade information in other portions of the model does not imply that these areas are conflict-free.

3. Where 3D CAD files are provided, the following trades are known to be design-build and are thus incompletely represented if present at all:
 - a. Fire protection / sprinkler routing.
 - b. All electrical conduit locations.
 - c. All controls conduit.
 - d. All telecommunications conduits and cable tray.
 - e. All trades' support and seismic bracing details.
 - f. All trades' vibration isolation and thermal expansion devices.
 - g. All trades' access area limitations.
 - h. Ceilings and their supports.
4. 3D files are to be used as guides in the same way as the 2D drawings mentioned above, in that dimensions are not guaranteed. The dimensional distance from a column line or the dimensional elevation within the 3D drawings are not to be interpreted as fixed engineering design direction, but rather as the representation of intent, given the available information during the construction document design phase. As other trades' design input show a conflict, it will be necessary for the mechanical Subcontractor to perform the work of field coordination, at no cost, as required by Division 1.
5. Any conflicts between 3D files, 2D files, sections, detail drawings, single line drawings, and specifications are to be resolved by a Request for Information (RFI).

C. Minor Deviation from Construction Documents

1. The equipment listed by model number and manufacturer in the plans and specifications has been selected for its capacity, certain standard construction features, and specified optional features.
2. The dimensions and ratings of equipment herein specified or indicated on the drawings are intended to establish the desired performance characteristics of such equipment. Minor deviations may be permitted, after review by the Owner, to allow manufacturers specified to bid on their nearest standard equipment that provides at least the performance required.
3. Manufacturers' catalog or model numbers and types mentioned in the Specifications or indicated on the drawings are intended to be used as guides and shall not be interpreted as taking precedence over specific ratings or duty called for or shown, which modify stipulations in such catalogs. In all cases, the manufacturer shall verify the duty specified with the particular characteristics of the equipment he intends to submit, and shall submit only items which comply with specification requirements.
4. Where the equipment furnished differs in physical character from that specified or indicated, or where Contractor's substituted equipment requires increased service and facilities to be provided by other trades, and such substitution is acceptable to

the Owner, the Contractor shall bear all costs of providing services, facilities and modifications to the system or building.

5. Where the equipment furnished requires redesign of systems, connections, or configuration, and such substitution is acceptable to the Owner, the Contractor shall bear all costs associated with design engineering and shall pay the time and materials cost of the Owner's review of this documentation. In addition, it is the Contractor's responsibility to obtain approval from the authority having jurisdiction.
6. The shifting of any item horizontally by less than 10', the change of any elevation by less than 3', the resizing of ductwork for equivalent frictional loss, and the necessary fittings in order to accomplish this shall all be construed as accommodation for field coordination and cannot be back-charged as change orders to the client if changes are made during shop drawing development and before fabrication and installation. Changes caused after fabrication and installation may not be charged as change orders to the client unless an owner-directed change required the modification of as-built conditions

1.9 SUBMITTAL PROCEDURES

- A. Section 013300 – Submittal Procedures: Submittal Procedures apply to this section. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Preliminary Submittals

1. Preliminary list of materials, equipment, and suppliers

- a. Submit a preliminary list of materials, equipment, and suppliers for the Owner (in table format) for approval of manufacturers of all materials and equipment proposed to be provided for this project. Submit at least two months prior to the first submittal.
- b. List shall include:
 - 1) Specification section number.
 - 2) Equipment type.
 - 3) Proposed manufacturer and model number.
 - 4) Proposed supplier and supplier's contact information.
 - 5) Indicate whether manufacturer is the basis of design in drawings and schedules.
 - 6) Indicate whether manufacturer is listed in specifications.
 - 7) Provide a response column for completion by Owner, labeled 'Notes from Reviewer'.
- c. List will be returned to the Contractor with response to whether the particular manufacturer is rejected due to poor past performance or known incompatibilities with the requirements. Lack of comment in these columns does not imply that the final manufacturer/model proposed will be acceptable.
- d. The review shall only be construed to be a general review that the manufacturer or supplier is a recognized and reputable supplier of that general type of product or service and therefore eligible to submit in detail for review. Approval of the preliminary list does not exempt the Contractor from proving that the particular and specific equipment or supplier meets the specification and performance requirements during the submittal phase.

2. Submittal Schedule

- a. Provide a submittal schedule at least two months prior to the first detailed submittal.
- b. The submittal schedule shall be a complete list of all submittals to be made with submittal number, projected date of submittal, description of submittal by Specification or drawing number and whether a substitution is proposed.
- c. The submittal schedule shall include worst-case submittal status, resolution date and the critical path's target installation date, assuming at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Complicated and/or cross referenced submittals, such as controls and motorized machinery, shall incorporate time for at least two "Revise and Resubmit" cycles. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.
- d. Concurrent submissions of multiple submittals shall incur a minimum of two times the turnaround time listed in Division 1, or longer, as agreed between reviewing party and the Owner, based upon the amount and detail level of the documents requiring review. The following items shall be submitted for concurrent reviews:
 - 1) All controls submissions shall arrive concurrently to allow cross-referencing.
 - 2) All air handling equipment and duct silencers shall arrive concurrently.
 - 3) All hydronic equipment shall arrive concurrently.
 - 4) All VFD submittals (including those embedded in equipment submittals as integral devices and those provided under other divisions) shall be included in VFD harmonic mitigation calculation submittal for reference.
- e. The Contractor shall be responsible for equipment ordered and/or installed prior to receipt of submittals returned bearing the stamp of "No Exception Taken". Corrections or modifications to equipment as noted on returned submittals shall be at the Contractor's sole expense without additional compensation.

3. Shop Drawing Schedule

- a. Provide a shop drawing submittal schedule that includes fixed dates of inter-trade coordination sign-off prior to submission, including TAB and controls Contractor.
- b. The schedule shall be a complete list by drawing number of all shop drawings to be made, along with projected date of submission, worst-case shop drawing status resolution date, and critical path's target installation date.
- c. The submittal schedule shall assume at least one "Revise and Resubmit" cycle, and shall include the turnaround time period per Division 1. Delay to schedule associated with submittals' "Revise and Resubmit" designation are ineligible for change orders or extensions of time, as timely and correct work is a requirement of this contract.

C. General Organization of Submittals

1. Submit as a minimum all the required data listed in the documents as specifying performance, material, and dimensions. Refer to individual specification sections, schedules, and drawings for requirements.
2. Each submission shall be made under the Specification Section Number and clause it has been specified under. Submittals including equipment specified under a different specification section will be rejected and returned without review. Each Specification section is required to be tracked separately for status designation, even

if multiple sections are physically collated into a single binder or electronically submitted as single documents. Each specification section shall be tracked under a separate transmittal with unique number and include all items specified in that section.

3. Illegible submittals will be rejected and returned without review.
4. Include all information requested by the Specification Section in a single submittal. With the exception of shop drawings, incomplete submittals or phased submittals under the same specification section are not acceptable and will be returned without review, with the Contractor responsible for any resultant consequence.
5. Submit pertinent catalog and performance data sheets only. Annotate pages to clearly identify which specific product is submitted and for what clause, tag number or application. Contractors shall not submit entire catalogs, extraneous information or optional choices. Contractor shall cross out any irrelevant information that may exist on the page, including irrelevant options or alternative model types.
6. Submission shall be made in electronic format typically consisting 8½"x 11" pages or 11" x 17" as directed under Division 1. Provide the number of submittal and shop drawing copies as defined under Division 1. Index/table of contents sheets shall be required for all submittals and shall be set up, in the same sequence as the specifications, with columns to identify the following:
 - a. Specification clause number.
 - b. Item type.
 - c. Tag number as appropriate and/or description of application.
 - d. Equipment or manufacturer substitution request: yes or no
 - e. Notes from Contractor

D. Equipment Submittals:

1. Identify each item by manufacturer, brand, trade name, number, size, rating, and any other data is necessary to properly identify and check materials and equipment. At a minimum, this should include all information scheduled or explicitly specified. Words "as specified" are not sufficient identification.
2. Mark the exact equipment item and data on each sheet according to the identification numbers appearing on the equipment schedules. Where multiple product model types are listed on a single sheet, the Contractor shall clearly indicate which specific item is submitted. If different model numbers of a single product line are submitted for different uses, this should be clearly annotated, identifying each individual use cross-referenced by the requirement it intends to fulfill. Submittals without annotation will be rejected and returned without review.
3. Submittal literature, drawings and wiring diagrams shall be specifically applicable to this project and shall not contain extraneous material or optional choices. Clearly mark literature to indicate the proposed item and its relevant features or options. Submittals shall include all those items listed in each individual Section.
4. Where a certificate from a regulatory agency cannot be provided at time of submission, provide a letter describing methodology used to obtain certification, authority having jurisdiction, and anticipated date of certification. A separate submittal number shall be opened to track it.
5. All built-up equipment (such as air handling units or pump packages) shall be provided with a fully dimensioned shop drawing showing all hardware, points of connection, point loads at supports and center of gravity.
6. Submittals for all factory-built equipment weighing 40 lbs. or more shall include a dimensional drawing, equipment weight, and center of gravity.

7. Provide the name and contact information for the three closest manufacturer representatives/service companies for the product.
8. All equipment shall be UL listed as a complete assembly. Submit UL listing documentation with equipment submittals.

E. Shop Drawings:

1. General:

- a. Prepare and submit shop drawings for all work on Contract Drawings. Clearly indicate deviations and cross reference through notes the reason why the deviation was made.
- b. Prepare reproducible drawings in a 3D format. The drawings shall be minimum 1/4" = 1'-0" scale.
- c. Shop drawings shall be provided for all systems included in Division 23 and for all areas addressed in the Construction Documents. Shop fabrication, coordination and installation drawings that are prepared to scale by the Contractor are for his use and shall be his responsibility. These drawings indicate where he intends to install the material and equipment as required by the Contract Documents. Drawings may be prepared by vendor but shall be submitted as instruments of the Contractor. Such drawings shall be thoroughly checked and developed by the Contractor to include the full contract scope. They shall be stamped by Contractor before submission for review.
- d. Submission of contract documents or electronic files of contract documents for shop drawings is not sufficient as this would be an indication that field-level construction coordination has not taken place. Any such submittal will be rejected and returned without review.

2. Coordination:

- a. Penetration locations, structural support, and structural pad drawings shall be submitted for review by Structural Engineer. Drawings shall clearly show all required openings in construction, and support locations and loads.
- b. Points of connection to other trades shall be clearly shown.
- c. The Contractor shall ensure that each trade has coordinated work with other trades. Prior to submittal of Division 23 shop drawings, coordination drawings are to be signed off by all other trades. Any conflicts that occur with other trades shall be brought to the attention of the Owner prior to issuance of the shop drawings.
- d. During the shop drawing review process the Owner may request that supplementary shop drawings be produced for clarification and explicit demonstration of coordination in congested areas. This work shall be performed by the Contractor at no cost as necessary under the previous clause.
- e. Prepare and submit supplementary shop drawings for all Work in "tight" areas, clearly indicating solutions to space problems and coordination with Work in other Sections. Identify congested conditions and provide a sufficient number of sections to demonstrate the solution proposed. These drawings, as a requirement of this Division, shall indicate, superimposed, Work of all Sections involved in congested area, including ductwork, piping, electrical work, ceiling work, equipment access requirements, etc. Include all mechanical rooms at larger scale and with sections under this clause. Identification of space problems without solutions is not acceptable within a shop drawing.
- f. Roof opening and Curbs

- 1) Roof Openings: All roof openings shall be sleeved prior to pouring of concrete.
 - 2) Roof Curbs: Prefabricated roof curbs shall be of the standard or sound attenuating type and shall be a minimum 12 inches high above roof surface.
 - 3) Flashing and Counterflashing: Flashing around roof curbs shall be as detailed on the architect's drawings. Counterflashing shall be required on curbed openings and shall be 16 ounce CRC, except where counter flashing is a component part of equipment.
3. Specific Requirements:
- a. All equipment shall be labeled to match the schedules. All equipment shall be drawn to scale per the approved submittals.
 - b. All equipment access clearances shall be marked explicitly on the shop drawings with manufacturer and code required distances dimensioned and annotated as such.
 - c. Ductwork and piping installation drawings shall be fully dimensioned complete with elevations. Include details and dimensioned locations (from gridlines) of supports, anchors and expansion devices.
 - d. Provide sections and elevations for all mechanical rooms, mechanical areas, areas with routed duct mains, areas with routed piping mains, and areas connecting to utilities or existing buildings.
 - e. Ductwork and Piping shall be on separate drawings.
 - 1) Ductwork drawings shall include and show equipment with tags, access space, duct access doors, duct material and any reinforcing required, flexible duct, flexible connectors, duct support and seismic restraints, balancing devices, dampers, gauges/thermometers, controls sensors and devices, and penetration locations (including dimensions and elevation).
 - 2) Piping drawings shall include and show equipment with tags, access space, flexible pipe connectors, pipe support and seismic restraints, balancing devices, expansion devices, gauges/thermometers/Pete's plugs, controls devices, and penetration locations (including dimensions and elevation). Show minor piping including secondary drain pan overflow drains, automatic air vent piping, and condensate piping chemical water treatment piping. Note piping high and low points including all drain valves and vents required for complete venting and draining of the system.
4. No material or equipment shall be released for manufacturer or shipment without first obtaining the owner's representative approved shop drawings.

F. Coordinated Drawings:

1. Refer to Section 013300 Submittal Procedures for requirements.
2. Difference or disputes concerning coordination, interference or extent of Work between sections shall be decided by Contractor, his decision, if consistent with Contract Document requirements, shall be final.
3. Color Coordinated drawings (with different color per trade) or 3D model shall be provided for all areas with acceptance sign off from all trades required before shop drawing are submitted. Items include but not limited to:

- a. Structure - Beams, braces, trusses, gusset plates/flanges, equipment pads, structural openings, piping sleeves.
 - b. Architectural - Partition types, wall ratings, ceiling systems (including support and bracing), access panels.
 - c. Plumbing - Equipment, piping, valves, access requirements, points of connection and interaction with mechanical systems.
 - d. Electrical - Equipment, panels, conduits, bus ducts, equipment disconnect switches, access requirements, points of connection and interaction with mechanical systems.
 - e. Telecommunications - Panels, cable tray, conduit, pull boxes, access requirements.
 - f. Audio Visual Systems – All devices, cabling, access requirements.
 - g. Controls - Panels, conduit, sensors, devices, access requirements, points of connection and interaction with mechanical systems.
 - h. Fire Sprinkler – Standpipe, pre-action systems, piping, sprinkler heads, access requirements.
 - i. Fire Alarm Contractor – Devices, access requirements, points of connection and interaction with mechanical systems.
4. Mechanical Rooms:
- a. Mechanical plans shall take precedence over other disciplines with regards to placement of mechanical equipment and layout of electrical and plumbing equipment within rooms designated as “mechanical rooms.”
 - b. Drawings shall indicate coordination with work in other divisions which may be incorporated in mechanical spaces, including, but not limited to:
 - 1) Irrigation equipment and piping.
 - 2) Electrical equipment.
 - 3) Cable trays.
 - 4) Architectural features, including doors and partitions.
 - 5) IT/Electrical outlets.
 - 6) Plumbing equipment.
 - 7) Controls equipment.
5. Notes regarding mechanical requirements:
- a. Nothing shall enter or cross through the code-required and manufacturer recommended access space, which is defined as the volume extending from the top of the device to be maintained down to the floor (inclusive of access door locations and swings). Any ceiling which interrupts this space shall be entirely removable including T-bars, vertical supports, and seismic bracing of ceiling which shall be arranged to avoid the access zone.
 - b. Not all offsets in ductwork or piping are shown. Contractor shall decide which items to offset or relocate.
 - c. All equipment, ducting, piping, and accessories required to be shown in shop drawings shall be included in coordination drawings.

G. Substitutions:

1. Manufacturers:

- a. Subject to compliance with requirements and manufacturer's offerings, available manufacturer's offering products that may be incorporated into the Work include, but are not limited to, the manufacturers listed within each specification section.
 - b. The basis of design shall be the scheduled manufacturer. For small items such as valves, sensors etc. that are not scheduled, the first listed manufacturer shall be the basis of design. All other manufacturers shall be considered substitutions per Division 1. When substitutions are requested, the contractor shall ensure that all impacts on all trades are taken into account. No change orders associated with rework or new work by other trades to accommodate a substitution will be accepted.
 - c. All deviations from the basis of design manufacturer are considered substitutions and must comply with the requirements of this section.
2. Substitutions shall be made explicit during the project buy-out/bid phase (e.g. guaranteed maximum pricing). Selection of the Subcontractor does not imply acceptance of substitutions.
3. Limit submittal of substitutions to one proposal for each type or kind of item. If the proposed product substitution is rejected, submit the specified product at no cost to the project. Delays or additional work associated with a rejected substitution request are not eligible for change orders.
4. When a substitution is proposed, the Contractor shall be responsible to ensure that the performance and quality of the scheduled or specified equipment is met. If additional accessories are required to achieve performance, they shall be provided at no cost.
5. Substitution requests shall come simultaneous to the relevant submittal and shall not come through the RFI process, unless directed by the Owner. The first page of the submittal containing the substitution request shall explicitly include a table of contents identifying the location of the official substitution request paperwork, the table of comparisons, and the supporting data.
6. Submit shop drawings of proposed products that differ from the specified products to demonstrate equivalency of connections and physical arrangements. Show necessary modifications of architectural, structural, plumbing, electrical and mechanical work required by the proposed products, including relocation of drains, revised electrical circuits, relocation of roof or wall penetrations, and revised foundations.
7. Any additional work required by other trades as a result of a substitution shall be covered under this Contract, without any additional cost or time delay imposed on the project. Submittals with substitution requests shall include a letter signed by all affected parties (electrical, controls, testing, adjusting, and balancing, General Contractor, structural capacity) verifying that the substitution will not incur any additional cost or time delay to the overall project.
8. Review of drawings and other material submitted as a substitution shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, and to effect necessary rearrangement or construction of other work. The submittal response of "No Exception Taken" to a substitution request does not constitute a design change or a direction from the Owner and it is not eligible for a change order request.
9. Accompany the request for substitution review with a table of comparison listing pertinent features of both specified and proposed materials including all scheduled data, material of construction, performance criteria, overall length, width, height dimensions, space required for replacement or maintenance access, motor type,

horsepower, voltage, phase service factor, noise levels, and controls. This is to be submitted in addition to the index sheet required for all submittals. Review of proposed substitution will not be made without simultaneous receipt of satisfactory comparison tabulation. The substitution request shall also identify the offered reduction in contract value, which shall be inclusive of all cost associated with work by other trades. If paper copies of data from the referenced manufacturer are provided along with the submitted manufacturer as backup data for the table of comparisons, these shall be explicitly separated via tabs clearly marked as follows:

- a. Substitution request, comparison table, letter sign-off by all affected Subcontractors verifying that there is no charge to the project associated with the substitution.
 - b. Submitted data from requested manufacturer.
 - c. Reference data from specified manufacturer.
10. List of Materials and Equipment: Submit a list of materials and equipment in accordance with the procedure in Division 1 to the owner's representative for approval of manufacturers of all materials and equipment proposed to be provided for this project. The approval of the list of materials and equipment shall be subject to submission and review of shop drawings. If the list of materials and equipment is not received by the owner's representative within the prescribed time limit, provide the first named manufacturer for all material and equipment on this project.

H. Submittals - Checking

1. Before submitting shop drawings or equipment submittals to the Owner, the Contractor shall check them in detail to be sure that all requirements of the plans and specifications have been fully met.
2. Incomplete submittals and submittals not in accordance with the above requirements shall be returned without action, and resubmittal shall be required.
3. Review of drawings and other material submitted shall not be construed as a complete check or constitute a waiver of the requirements of the Contract Documents. This review shall not relieve the Contractor of the responsibility to fit the proposed materials to the spaces provided, to coordinate with the other trades, and to effect necessary rearrangement or construction of other work.
4. Review is not intended to verify dimensions or quantities, or to coordinate items shown on these drawings. Review is for general conformance with design concept of the project and general compliance with the information given in the Contract Documents. Contractor is responsible for dimensions, which shall be confirmed and correlated at the jobsite, for fabrication processes and techniques or construction, for coordination of his Work with that of all other trades, for installed performance and the satisfactory quality of his work.
5. Review by the Owner of submittals does not release the Contractor from full compliance with the requirements of the plans and specifications when submittals deviate from these requirements.
6. Even though submittals have been stamped and no exceptions have been taken by the Engineer, the Contractor shall be fully responsible for all unauthorized deviations from the drawings and specifications. Authorization for deviation will be made only by means of a letter from the Owner's representative. The Owner's representative's reviewed "No Exceptions Taken" stamp on a submittal is not an authorization for a deviation from the plans and specifications.
7. Any corrections or modifications made by the Owner shall be deemed acceptable to the Contractor with no change in contract amount unless written notice is received by

the Owner prior to the performance of any work affected by any corrections or modifications.

8. No material or equipment shall be released for manufacturer or shipment without first obtaining the Owner "No Exception Taken" response to the submittal or shop drawing.

I. Resubmittals

1. Resubmittals shall be reviewed for compliance with the comments made on the original submittal. Clearly identify replies to comments, through a cover letter by the Contractor that lists each comment and the resolution of that comment. Mark with submittal number and date.
2. Non-compliant items which were not noticed in an earlier submittal but are noticed in a resubmittal shall be noted as non-compliant and the resubmittal tagged for corrective action. The fact that the Owner may have overlooked the defect shall not constitute total or partial acceptance of it. The Contractor remains responsible for delivering an installation that meets the design intent. All corrective action shall be performed at no additional cost or delay to the project.
3. Resubmittals shall be complete and shall be explicitly annotated to note all changes. Contractor shall not just include specific responses to review comments, but shall show how the resubmittal data has been corrected and how all consequences of the change have been accommodated.
4. Changes made in the resubmittal which are not directly a response to an earlier review comment shall be clearly identified on the letter of transmittal provided with the re-submittal and annotated within the body of the submittal. The reason for the change shall be included.
5. One resubmittal will be reviewed. Review time for all second and higher resubmittals will be charged on a time and materials basis to the Contractor regardless of the cause of the resubmittal. This will include all submittals to change manufacturer or equipment type after an original submittal was returned with no exceptions taken, unless the change is directly related to a Bulletin.

1.10 PROJECT RECORD DOCUMENTS

- A. In accordance with Division 1- Execution and Closeout Requirements: Record Documents, and as follows.
- B. Keep up-to-date during the progress of the job through, one set of drawings indicating the record installation. In addition to changes made during course of Work, show following by dimension from readily obtained base line reference points:
 1. Exact location, type, and function of all valves, dampers, and controllers (cross referenced to valve, damper and sensor/controller charts).
 2. Exact size, invert elevations and location of underground and underfloor piping and ducts, and ducts and piping concealed or exposed in walls.
 - a. Dimensional changes to drawings.
 - b. Revision to details shown on drawings.
 - c. Depths of foundations.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.

- h. Duct size and routing.
 - i. Locations of concealed internal utilities.
 - j. Changes made by Change Order or Construction Change Directives.
 - k. Details not on original construction drawings.
- C. A complete progress set of drawings shall be kept on the project site at all times and shall be available for inspection by Owner or Construction Manager weekly, as a “record” set.
- D. Each trade shall submit record copies of their respective shop drawings as part of the project closeout. These record copies shall indicate as-built conditions and shall show all work installed by that trade. All elements shall be dimensioned from grid lines or bench marks and all elevations shall be noted. Construction notes such as component number or conflict notes shall be removed and the drawings shall clearly be noted in the title block as being as-built drawings.
- E. Newly Prepared Record Drawings: Prepare new drawings instead of following procedures specified for preparing record drawings where new drawings are required when neither the original Contract Drawings nor Shop Drawings are suitable to show actual installation. New drawings may be required when a Change Order is issued as a result of accepting an alternate, substitution, or other modification.
 - 1. Provide drawings in a scale that allows for scope of detailing and notations required to record actual physical installation and its relationship to other construction.
 - 2. When completed and accepted, integrate newly prepared drawings with procedures specified for organizing, copying, binding and submitting record drawings.
- F. Submit as a normal submittal, a copy of the completed progress set drawings and the final draft of the project record drawings to Owner for approval prior to authorization for final payment. Record drawings shall be certified as to their correctness by the signature of the Contractor and shall be stamped or otherwise identified as record drawings.
- G. Prior to Final Acceptance, submit record drawings to the Owner. Organize into sets, and bind and label.
- H. At the completion of the project prior to the authorization for final payment, the Contractor shall submit record as-built drawings with numbers of copies as specified under Division 1 and their electronic 3D files, including all associated reference files, files related to line weights/color for printing, and a PDF print of the intended final drawing product. Drawings shall incorporate all the Owner’s comments and corrections, submittal information, RFI information and all addenda and represent completed as-built conditions. Reference to RFI’s or Change Orders in lieu of drawing the exact change will not be acceptable. Title block shall explicitly note these as “PROJECT RECORD DRAWINGS” in a prominent location on each drawing.
- I. Contractor shall deliver rolls or binders that contain each drawing, whether or not changes and additional information were recorded, such that each copy is a complete as-built representation of the installed work.
 - 1. Organize hard copies into manageable sets. Bind each set with durable-paper cover sheets. Include appropriate identification, including titles, dates, and other information on the cover sheets.
 - 2. Organize and bind original marked-up set of prints that were maintained during construction period in same manner.

3. Submit marked-up progress set, record set, 3D files, and copy sets to the Owner.

1.11 CLOSEOUT SUBMITTALS

- A. Contractor shall provide copies of the “O & M” manuals, copies of the as-built drawings, an electronic copies of all as-built 3D files, and the final air and water balance report as part of the close-out package (numbers of copy per Division 1). These shall fulfil the requirements of the Occupational Health and Safety Act (OSHA).
- B. Operating and Maintenance Instructions and Manuals shall include the following
 1. Manufacturers’ recommended maintenance requirements
 2. List of parts that are replaced as part of standard maintenance with indication of normal expected life span.
- C. Provide number of copies of O & M manual in accordance with requirements of Division 1 , and parallel electronic documentation organized in directories. Additional requirements are as follows:
 1. Provide a minimum of 8 hours Owner training for each major system (e.g. chilled water central plant, heating hot water central plant, air handling units, BAS, etc.). Provide a minimum 4 hour Owner training session for the building’s minor systems (e.g. toilet exhaust fans, valves, etc.). System training shall include the items below.
 - a. System overview (what it is, what it does and with what other systems and/or equipment it interfaces).
 - b. Review and demonstration of servicing/preventative maintenance.
 - c. Review of information in systems manual.
 2. Submit certificate, signed by Owner, attesting to their having been instructed per Division 1 and as specified under individual Equipment sections of this specification.
 3. Instructions on major items such as fans, air handling units, and temperature control shall be by a representative of manufacturer of the respective equipment.
 4. Schedule training with Owner a minimum of 14 working days in advance. All Owner training shall be completed prior to scheduling final inspection. All training shall be videotaped by a commercial photographer with two copies of DVDs provided to the owner..
 5. One month prior to request for final inspection, submit Operating and Maintenance manuals and electronic documentation under Division 1.
 6. Manuals shall be prepared to ASHRAE Guideline 4-2008. The manuals shall be predominately typewritten with occasional printing or hand-drawn demarcations and notes. Shall include the following in the Mechanical Equipment Binder(s):
 - a. Section 1: Overview documents:
 - 1) A comprehensive table of contents and guide to the manuals contents and layout. This section shall enable the reader to comprehend the scope and purpose of the document and to identify readily where specific information can be obtained.
 - a) Systems manual to include the following:
 - b) Site information including facility description, history and current status/occupancy

- c) Site contract information
 - d) General site operating procedures
 - e) Site events log
 - 2) Equipment List: List of all major equipment as installed. Include tag reference model number, normal capacities, location in building, and location tab number in Section 3 binders.
 - 3) Manual valve charts organized on a room and sequence basis, identifying room, system, valve numbers, valve type, valve usage, and associated equipment.
 - 4) Fire and fire smoke damper charts organized by type on a room and system basis, detailing room system and damper number.
- b. Section 2: Contractual and Legal Records including:
- 1) Name and Address of the installation.
 - 2) Contact Name and telephone number for emergency repairs.
 - 3) Details of City and State approvals.
 - 4) Name and Contact details of the Design Team and Installing Contractors and associated Subcontractors.
 - 5) Copies of maintenance service contracts and contact details for local service company.
 - 6) Master Equipment List containing Dates for Start of Installation, Substantial Completion, and Expiry of Warrantee period.
 - 7) Copies of warranties, guarantees and bonds.
- c. Section 3: System Description
- 1) System Description: for each system in the building, provide a written narrative describing system components and operation. Include any technical details surrounding why the system is configured as designed and any other issues that may lead to a better understanding of the system operations.
 - 2) System Flow Diagrams/ Single Line Diagrams: for each system, provide as-installed flow diagrams indicating system operations in normal mode. Integrate all system components into a single master comprehensive diagram per system.
 - 3) Valve Charts: Provide a comprehensive chart listing valve tag numbers with the location and function of each valves clearly tagged against the respective system flow diagram.
- d. Section 4: Individual Equipment Sections:
- 1) Startup and Shutdown Procedures: Provide a step-by-step write-up of all major equipment. When manufacturer's printed start-up, troubleshooting and shut-down procedures are available, they shall be incorporated into the operating manual for reference.
 - 2) Operating Instructions: Written operating instructions shall be included for the efficient and safe operation of all equipment.
 - a) Description of Emergency Scenarios and Failure Modes.
 - b) Basic troubleshooting advice.

- 3) Service/Maintenance Instructions: Provide the following information for all pieces of equipment:
 - a) A detailed parts list
 - b) Recommended spare parts, including catalog number and the name, manufacturer's name and contact information, address and telephone number of local suppliers or factory representative.
 - c) Lubrication and maintenance instructions and recommended service maintenance schedule for all equipment including all electric motors. Sample maintenance record forms for each equipment type.
 - d) A lubrication chart listing each item of equipment, all points of lubrication, proper lubricant, dates lubricated, and lubrication schedule.
 - e) Belt sizes, types and lengths - adjustments made to install systems.
 - 4) Data sheets to show model number, capacity, nameplate data, complete internal wiring, mechanical and electrical ratings and characteristics, catalog data on component parts whether furnished by equipment manufacturer or others, names, addresses and telephone numbers of source of supply for parts subject to wear or electrical failure, and description of operating, test, adjustment, and maintenance procedures.
 - a) Where data sheets included in the manual include equipment, options, or other features not part of equipment actually furnished, line out these references or otherwise clearly mark so remaining text, diagrams, drawings, schedules, and similar information shall apply specifically to equipment furnished.
 - b) Parts catalog references for each item of equipment furnished with components identified by number for replacement.
 - c) Final submittals for equipment shall have final corrections included in the points used for the manual.
 - 5) Testing and Balancing reports:
 - a) Sheets detailing all set points, and final balance figures of air and water systems.
 - b) Cross-reference diagrams in plan to identify air terminals and equipment location.
 - c) NC levels by room (as required by the TAB specification).
 - d) Pressurization testing results (as required by the TAB specification)
- e. Section 5: Controls:
- 1) Title index tabs identifying items therein.
 - 2) Detailed list of all sensors, devices, and controllers cross reference to control set points names. List shall cross reference physical location in building, control and wiring diagrams and documentation in this section.
 - 3) Software name/version and support contact information.

- 4) Detailed description of sequence of operation of each system, with charts and diagrams. Include emergency operation performance and resetting procedures as appropriate. Include explicit definition of all setpoints, alarm triggers, loop tuning coefficients, and ranges present within programming at time of handover.
- 5) Provide full size copies of record one-line diagrams and plans, thin laminated and folded into plastic envelopes for inclusion in the binder.
- 6) Provide laminated control diagrams. Diagrams shall show complete equipment, controls, model numbers, etc., marked to correspond to identification on equipment.

f. Section 6: Certifications:

- 1) Title index tabs identifying items therein.
- 2) Certificates: Submit final inspection certificates signed by governing authorities.
- 3) Letters from manufacturers certifying their supervision of equipment installation and start-up procedures.
- 4) Machinery vibration test reports.
- 5) Room NC levels at handover as tested by an acoustical engineer.
- 6) Test certificates.
- 7) Instruction certificates.
- 8) Inspection certificates.
- 9) Fire Marshal and/or Fire Department approvals of system.
- 10) Final inspection certificate signed by governing authorities.
- 11) UL, ASME and ASTM rating certificates (as appropriate).
- 12) Other certification as noted in other Division 23 sections.

g. Section 7: Record As-Built Drawings: Submit drafts of service and maintenance instruction sheets to Owner for review before preparing final sets.

1.12 COORDINATION

A. Section 013300 –Project Management and Coordination: Coordination, Field Engineering, Electrical Characteristics, Cutting and Patching.

B. Field coordination between trades shall be the sole responsibility of the contractor.

1. Coordination with other trades for considerations with the following

- a. Equipment curbs and pads
- b. Machinery foundations and supports
- c. Stairs, platforms and gratings for access to main machinery (i.e. RTU's, large EF's);
- d. Wall openings for ventilation louvers;
- e. Sumps, trenches and tunnels with necessary covers and gratings;
- f. Louvered or undercut doors;
- g. Routes for kitchen hood grease exhaust ducts and vertical duct risers, which will require access every 20ft on horizontal run and every floor level on vertical;
- h. Access doors to valves, dampers, and the like.
- i. Adequate space for horizontal and vertical duct and pipe installation.
- j. Vertical shafts and chases without horizontal offset.

- k. Vertical shaft termination in or conveniently close to mechanical rooms.
- 2. For equipment in the building other than in a mechanical room, provide the following
 - a. Ensure that all parts of the system have not less than 6'-6" headroom for both approach and working areas
 - b. Ladder access is acceptable only for small, light, or infrequently serviced equipment and must be direct, via an access panel but not requiring the maintenance person to go into a crawl space.
 - c. Provide access openings to pipe and duct spaces at each floor. Enclosures shall meet fire separation and safety requirements of the applicable codes as set forth by IBC, NFPA, California Fire Marshall and all other authorities having jurisdiction.
 - d. Provide ceiling and wall mounted access panels to all equipment requiring adjustment, replacement or maintenance. Access includes but not limited to, fire dampers, hydronic valves, trap primers, VAV controllers and dampers, combination fire/smoke dampers, control devices, duct access doors and manual volume dampers. Locations shall be shown on shop drawings and shall be approved by architect/engineer prior to framing and installation of the panel. Whenever possible, locate panels in such a way to utilize single panel to access multiple devices. Equipment shall be within easy reach from the openings without requiring personnel to stretch or leave access platform. When permissible, access panels shall be at least 28" x 28" clear inside dimensions. Where components are located above T-bar ceilings, careful consideration must be given to the unit location to accommodate convenient access.
 - e. Access door for grease exhaust duct shall be located at side or on top in compliance with code.
- C. Cooperate with all other Divisions performing work on this project as necessary to achieve a complete neatly fitted installation for each condition. Consult the drawings and specifications to determine nature and extent of work specified in other divisions that adjoins, shares space with, or attaches to the work of this division. Confer with other divisions at the site to coordinate this work with theirs in view of job conditions to the end that interferences may be eliminated and that maximum headroom and clearance may be obtained. In the event that interferences develop, the Owner's decision will be final as to which Division shall relocate its work, and no additional compensation will be allowed for the moving of piping, ductwork, conduit or equipment to clear such interferences.
- D. For Testing and Balancing of the system, ensure full co-ordination between the Testing and Balancing Subcontractor and all other Trades to achieve access to all system components including leaving wall/ceiling sections down for access.
- E. Coordination with Architectural Work:
 - 1. Access Panels:
 - a. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."
 - b. Place no valves, traps, controls, unions, dampers, coils, air distribution boxes, cleanouts, junction boxes, pull boxes, expansion joints, etc., in any system at a location that will be inaccessible after construction is completed. Maintain accessibility for all components in systems.

- c. Provide information to the party responsible to furnish and install Division 8 Access Doors regarding location and size of all access doors required for all items requiring removal or maintenance access. This applies for all equipment located above finished ceilings, ceiling breaks or extensions behind finished walls or below finished floor, even though access doors may not be shown with the documents of this Division. Mark each door with a hidden identification tag cross-referenced to a plan location to ease installation and future access by others.
 - d. Sizes: 12 x12 inches for easily accessible items within 6 inches behind walls; 18 x 18 inches where partial body access is required; 24 x 24 inches at ceilings or where entire body access is necessary.
2. Painting:
- a. All unpainted, non-insulated, non-galvanized, ferrous metal surfaces of pipes, equipment, fixtures, hangers, supports, and accessories painted under Section 099000 - Painting and Coating.
 - b. Properly prepare Work under this Division to be finish painted under Section 099000 - Painting and Coating.
 - c. Refinish Work supplied with final finish under this Division if damaged under this Division to satisfaction of Architect.
 - d. Provide moisture resistant paint for exterior painting and heat resisting paint for hot piping, equipment and materials.
 - e. Provide factory finishes as noted in the individual Equipment Sections.
 - f. For the following, provide factory prime coat. Provide colors as directed by Architect unless specified otherwise.
 - 1) Air inlets and outlets: identified within relevant section to be painted to match adjacent mounting surfaces.
 - 2) Access panels.
 - g. Paint all equipment out-of-doors and equipment supports with two coats of weather resistant enamel.
 - h. Acceptance: Prior to finish painting and final acceptance by owner's representative, touch up scratches or blemishes in prime coats and factory finishes.
3. Cutting and Patching:
- a. Contractor shall do all cutting and patching of building materials, piping, etc. as required for the installation of his work. No structural members shall be cut without the approval of the owner's representative and any such cutting shall be done in a manner satisfactory to the owner's representative.
 - b. Patching of building structure, walls, floors, etc. during normal work progress with Requirements of Section 013300.
 - c. All patching of or repair of damage to completed work in place shall be done to meet with the approval of the Owner.
 - d. Work in place that is subsequently cut is seen as evidence of the Contractor's lack of field coordination during the shop drawing production phase. Because field coordination is a requirement of the contract, the Contractor must bear all costs of cutting, patching and repair for corrective work.
 - e. Assume responsibility for damage to any part of premises or Work of other Divisions, caused by leaks or breaks in piping or equipment furnished or installed under this Division during construction and guarantee/warranty period.

- f. Provide sleeves, caps, plates, escutcheons, flashing, etc., required to fill or close the openings. Provide final grouting, concrete, asphalt, masonry, painting and other materials as required. Make repairs in like and kind for exact patching or surfaces and finishes.
- g. Where cutting and patching occurs in streets, sidewalks, alleys and the like, cooperate fully with Owner and municipal or other government bodies.
- h. All patching shall be equal to the condition of the element prior to cutting as defined by the Owner.

F. Coordination with Structural Work:

1. Schedule of Work:

- a. Arrange work to conform to schedule of construction established or required to comply with Contract Documents.
- b. In scheduling, anticipate means of installing equipment through available openings in structure.
- c. Ascertain temporary openings required for admission of apparatus. Notify the General Contractor and Architect accordingly. Provide such openings at no additional cost to the Owner.
- d. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- e. Where any Mechanical work cannot be installed as the work progresses, the Contractor shall provide and arrange for the building in of boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. This field coordination work shall be completed prior to structural shop drawings and shall follow the principles set forth in the meeting reference above. Arrange for and lay out any chases, holes, or other openings that must be provided in masonry, concrete or other work.
- f. This work shall be incorporated into the initial shop drawing review of the construction (wall, floor, etc.) that is affected so that the Owner may review the impact of the holes.
- g. Once the structural shop drawings are returned with no exception taken, the Contractor shall bear the cost of time and materials for the Owner to review the appropriateness of cutting or drilled holes in planned or existing construction.

2. Penetrations:

- a. The Contractor shall be responsible for being aware of the nature and arrangement of the materials and construction to which the work attaches or passes through, and shall propose support and penetration details that are consistent with maintaining the integrity and performance of the construction such as, but not limited to, fire-resistive construction, acoustically rated construction, vibrated isolated construction, water tight construction, fire proofed construction, and isolated construction.
- b. At the start of the project, meet with the Owner to obtain information regarding allowable sleeve or penetration spacing and size. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.
- c. The Contractor shall be responsible for ensuring that all openings shown on the drawings or otherwise required are provided by the relevant trade Contractor during the construction of the wall or roof.

- d. Openings and penetrations are prohibited in structural members, except where shown or as directed by the Owner and the building's Structural Engineer in writing.
3. Cutting:
- a. The Contractor shall do all cutting, sleeving, core drilling and carpentry of building materials, piping, etc., as required for the installation of work and in accordance with Division 1.
 - b. All cutting shall be performed with machine saw. Holes for pipes in concrete walls or floors shall be drilled with core drilling equipment. Verify location of all such cutting or core-drilling with the structural engineer prior to execution.
 - c. No structural members shall be cut or drilled without the prior approval of the Owner. To gain approval to cut concrete, X-ray the affected area (or use another non-destructive method to examine the affected area) and submit results to Structural Engineer for review. Submit to Owner, drawings and details for the support of structure around the opening. If the standard structural details are to be used, then submit a plan that cross-references all penetrations (including partial penetrations for anchors) against detail numbers for review. Otherwise, submit drawings, design, and calculations stamped by a Registered Professional Structural Engineer in the state in which the project is located. Any cutting and remedial support shall be done in a manner satisfactory to the Owner.
 - d. The Contractor shall bear the cost of time and materials for the Owner to re-analyze the construction if the original penetration spacing principles are not adhered to, for whatever reason.

G. Coordination with Electrical Work:

- 1. Division 26 Contractor: Wire all mechanical equipment furnished by this division (excluding internal factory wiring) in accordance with the following general provisions:
 - a. Provide 120-volt emergency power circuits available at panel for Control Contractor's use.
 - b. Provide and wire heavy-duty, quick-make, quick-break type disconnect switches, manual pushbuttons, and other fire alarm hard-wiring specifically called for in the documents or noted in electrical specifications and wherever required by Code. This excludes factory-mounted disconnects on equipment.
 - c. Provide final equipment connections for all equipment that require motor starters. Include starter, overcurrent protection, and disconnect.
 - d. Receive, unload, set, and rough align all separately shipped motors.
 - e. Receive, unload, set and install all motor starters and variable frequency drives, except those clearly specified as an integral piece supported on the body of a piece of equipment.
 - f. Provide final equipment power connections for all equipment with voltage 110-volt and greater, including overcurrent protection and disconnect.
 - g. Provide final connection to motorized smoke and fire-smoke dampers with voltage 110-volt and greater.
 - h. Wire all miscellaneous solenoid valves, relays, and other components provided with equipment which is not factory wired or part of Control Contractor's scope.
 - i. Wire interlocks between equipment as called for in Controls specifications.
 - j. Wire lighting controls and other monitoring systems for interface with Building Management and Control System.

- k. Provide 120V wiring and conduit from electrical panel to dedicated J-boxes located for Controls Contractor's exclusive use. Provide a disconnect switch for each final connection.
2. Division 23 shall provide the following:
- a. Electrical work in this Division shall conform to the requirements of Division 26.
 - b. Complete and accurate wiring diagrams to Division 26 for all equipment requiring electrical power wiring.
 - c. All motor starters and variable frequency drives or control devices called for to be factory prewired to mechanical equipment.
 - d. All control devices noted on the drawings and within the specifications, including devices required to achieve Sequences of Operations but not explicitly mentioned or called out. Provide controls, controllers, relays, transformers, switches, etc. required by work of this division.
 - e. Information for separately shipped motors and variable frequency drives to be installed by Division 26. Adjustable motor bases and all bolts and nuts required for installation of base and motor shall be provided and installed by Division 23.
 - f. Align and adjust mechanical coupling for direct-driven motorized equipment. Adjust and align drive and belt tension on belt-driven equipment.
 - g. Field lubricate all motors prior to operation and maintain lubrication prior to acceptance of equipment by the Owner.
 - h. Provide motor terminal connection diagram as prepared by motor manufacturers.
 - i. Provide low-voltage (less than 100V) control wiring from Control Panel or controller to controlled device.
 - j. Provide controls relay for Building Automation System's position monitoring of motorized smoke and fire-smoke dampers (in coordination with Division 28).
 - k. Equipment shall be ordered with factory-wired assemblies or panels, pre-wired to numbered terminal strips for connection to field wiring.
 - l. Provide weather-proof devices or protection for equipment outdoors, regardless of installing party.
 - m. Contractor to coordinate piping routing to ensure piping does not run above electrical equipment.
3. Division 28 Contractor: Wire all mechanical equipment furnished by this Division in accordance with the following provisions:
- a. Product of combustion (duct smoke) detectors to be furnished under Division 28. Damper and duct smoke detectors to be installed by Division 23. Duct smoke detector to be wired by Division 28 to the fire alarm system.
 - b. Provide hard-wired air handling equipment shut-down relay connection as required by code.
 - c. Provide hard-wired connections for smoke control systems.
 - d. Provide hard-wired connections for control to all motorized smoke and fire-smoke dampers.
 - e. Provide fire alarm system position-monitor wiring for all motorized smoke and fire-smoke dampers.
 - f. Provide Fire Alarm location signals to the Building Management System, as applicable.
4. Where drawings clearly and explicitly differ from the preceding wiring paragraphs, drawings have precedence.

1.13 SPARE PARTS

- A. Spare parts at handover shall include an extra set of belts for each motor and an extra set of filters for each filter bank.
- B. Coordinate with owner on additional spare part quantities to be provided for air handlers, chiller, cooling towers and boilers

PART 2 - PRODUCTS

- A. Not applicable

PART 3 - EXECUTION

3.1 TEMPORARY FACILITIES

- A. Temporary heating, ventilation, and air-conditioning: Provide conditioning as desired or required by the authority having jurisdiction from conditioning sources that are independent of the building's air handling systems. Building air handling units shall not be used during construction unless explicitly approved for use by the Owner. If air handlers are used, then MERV 8 filters must be provided on all return air openings in compliance with the temporary ventilation provisions of the California Green Building Code.
- B. Owner may require operation of parts or all of respective installations prior to final acceptance. Cost of utilities for such operation shall be paid by Owner. Operation of installation shall not be construed as acceptance of work.
- C. Assume responsibility for chemical treatment and freeze protection during use of temporary facilities.
- D. All temporary facilities shall be removed at completion of project, with permanent facilities returned to proper working order and thoroughly cleaned.

3.2 LOCAL AND EXISTING CONDITIONS

- A. Prior to bidding visit the site and determine all existing conditions affecting work in this Division. Examine all drawings and specifications to familiarize with the type of the construction to be used, and the nature and extent of work of other trades.
- B. Observe the conditions under which deliveries of materials and equipment shall be made and under which such materials and equipment can be stored, and shall include adequate provision in the bid proposal.
- C. Anticipate means of installing equipment through available openings in structure and make adequate provisions in the bid proposal.
- D. The location and elevation of the utilities, piping, conduit, or equipment is that which can be determined from available information and its accuracy cannot be guaranteed. Exact location and elevation of these items shall be verified by the Contractor prior to excavation, demolition, or installation of any portion of the work indicated. Exercise special care when excavating at or near the general location of underground utilities to avoid damage to the utility services, as well as to ensure worker safety. Any connections to or relocation of any

existing utility line requiring temporary discontinuance of utility services which are in active use shall be scheduled and coordinated with the Owner. In no case shall the services be left disconnected at the end of a working day or weekend unless authorized by representatives of the utilities and the Owner. Any existing utility service damaged shall be repaired to the satisfaction of the Owner.

E. Equipment Rough-In:

1. Equipment rough-in locations shown on mechanical drawings for equipment furnished by Owner and for equipment furnished under other divisions are approximate only. Obtain exact rough-in locations from following sources:
 - a. From Shop Drawings for Contractor furnished and installed equipment.
 - b. From Owner for Owner furnished-Contractor installed equipment
 - c. From existing equipment where such equipment is relocated under this Contract
2. Verify mechanical characteristics of equipment before starting rough-in. Where conflict exists between equipment and rough-in shown on drawings obtain clarification from Architect and provide as directed at no increase in Contract Sum.
3. Make final connections.

3.3 PROVISIONS FOR LATER INSTALLATIONS

- A. At the start of the project, meet with the Owner to obtain information regarding allowable sleeve or penetration spacing and size.
- B. Where any Mechanical work cannot be installed as the work progresses, the Contractor shall provide and arrange for the building in of boxes, sleeves, inserts, fixtures or devices as necessary to permit installation of the omitted work during later phases of construction. This field coordination work shall be completed prior to structural shop drawings and shall follow the principles set forth in the meeting reference above. Arrange for and lay out any chases, holes, or other openings that must be provided in masonry, concrete or other work.
- C. The Contractor shall be responsible for being aware of the nature and arrangement of the materials and construction to which the work attaches or passes through, and shall propose support and penetration details that are consistent with maintaining the integrity and acoustically rated construction, vibrated isolated construction, water tight construction, fire proofed construction, and isolated construction.
- D. This work shall be incorporated into the initial shop drawing review of the construction (wall, floor, etc.) that is affected so that the Owner may review the impact of the holes.
- E. The contractor shall bear the cost of time and materials for the Owner to re-analyze the construction if the original spacing principles are not adhered to, for whatever reason.

3.4 HOIST, RIGGING, TRANSPORTATION, AND SCAFFOLDING

- A. Provide all scaffolding, staging, cribbing, tackle hoist and rigging necessary for placing all materials and equipment in their proper places in the project. All temporary work shall be removed from the premises when its use is no longer required.
- B. Prior to placing equipment or scaffolding, the Contractor shall provide written verification that the structure on which the load is imposed has sufficient strength to accommodate the point and/or line loads.

3.5 PROTECTION, DELIVERY, STORAGE, AND HANDLING

- A. Conform to the requirements specified in Section 016000 - Product Requirements.
- B. Contractor to provide an authorized representative to constantly supervise Work of this Division, check all materials prior to installation for conformance with Contract Documents, and reviewed Shop Drawings.
- C. Delivery
 - 1. Deliver materials or equipment to the Project in the manufacturer's original unopened, labeled containers and adequately protect against moisture, tampering or damage from improper handling or storage, ingress of dirt or contamination of any kind. Do not deliver materials to the job before they are ready for installation, unless adequate security is provided.
 - 2. Perform all handling and shipping in accordance with manufacturer's instructions.
 - 3. All ductwork shall be delivered to site with all ends and openings capped with heavy gauge polythene sheeting taped all around to prevent ingress of moisture, dust, and debris.
 - 4. Deliver equipment in its original package to prevent damage or entrance of foreign matter. Perform all handling and shipping in accordance with manufacturer's recommendations. Provide protective coverings during construction.
 - 5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- D. Identification
 - 1. Identify materials and equipment delivered to site to permit check against approved materials list, reviewed Shop Drawings. Identify materials and equipment by manufacturer's name, tag reference and nameplate data. Remove unidentified materials and equipment from site.
- E. Storage
 - 1. All stock-piled material shall be placed on pallets, and protected from weather and from entry of foreign material and construction dust by plastic. All stored materials and equipment shall be carefully inspected and cleaned prior to installation and replaced with new material or equipment if found to be damaged, corroded, etc.
 - 2. Equipment which is observed to be exposed to the weather, dirt or construction debris can be interpreted by the Owner as defective equipment under this clause.
 - 3. All stored materials and equipment shall be carefully inspected prior to installation and replaced with new material or equipment if found to be damaged or corroded.
 - 4. Completely cover motors and other moving machinery to protect from dirt and water during construction, including after installation.
 - 5. Once installed, all electrical devices exposed interior materials and all insulation installed shall be covered with sealed plastic until the building is fully enclosed and all spraying applications are complete.
 - 6. Cap all openings in pipe and ductwork daily to protect against entry by foreign matter.
 - 7. Store plastic pipes protected from direct sunlight. Support pipe to prevent sagging and bending.

8. Protect all finished surfaces of fixtures and exposed to view materials with heavy plastic or by other means, throughout the period of construction.

F. Waterproof Construction

1. Maintain waterproof integrity of penetrations of materials intended to be waterproof. Provide flashings at exterior wall and roof penetrations. Caulk watertight penetrations of foundation walls, above grade walls, roofs, and floors. Provide membrane clamps at penetrations of waterproof membranes.
2. Provide galvanized sheet metal weather protection canopies, hoods or enclosures over all out-of-doors equipment, the operation or maintenance of which would be impaired by rain water. This requirement applies to damper operations and bearing, damper motors, controls and instruments. See other paragraphs in this Division for application of this requirement to motors, drive, ducts and fans.
3. If ductwork, piping, insulation or any damper or valve is installed in a riser prior to the permanent roof construction of that riser is complete, provide auxiliary sheet metal, drain piping, and caulking to ensure watertight caps on all temporary riser top openings that occur during the construction process. Take responsibility to ensure that watertight protection is provided continuously except when actual work is being done at the opening.

G. Loss or Damage

1. Protect premises and Work of other Divisions from damage arising out of installation of Work of this Division.
2. Repair or replace, as directed by Owner, materials and parts of the Owner's premises which become damaged as result of installation of Work of this Division. Remove replaced parts from premises.
3. Contractor shall be responsible for repair to work of all other Divisions caused by installation of the work of Division 23 or by leaks from piping or equipment furnished or installed under Division 23 during construction and guarantee/warranty period.
4. Where damage to another trades work occurs the Contractor shall pay the relevant trade contractor to make the repairs.
5. All repairs shall be equal to the condition of the element prior to cutting as defined by the Owner.
6. All materials, appliances, and equipment shall be new and free from defects, and of the make, brand or quality specified or as accepted by the Owner. All materials and equipment shall be installed in a neat and workmanlike manner. Any work not so installed shall be removed and replaced in a satisfactory manner at no charge to the Owner.
7. The Contractor shall replace lost or damaged materials and equipment with new at no increase in Contract Sum.
8. Repair and replace work installed by this Division when it becomes damaged.
 - a. Equipment or material damaged during transportation, installation or operation is considered as totally damaged. Replace with new.
 - b. Wetted insulation shall be considered damaged.
 - c. Any NEMA1 or NEMA2 motors for actuators that are wetted shall be considered damaged.
 - d. Any metal showing evidence of rust, white rust, or other corrosion shall be considered damaged.

- e. Any caulking or adhesive which is observed to be flaking, delaminating or otherwise appearing to lose its bond shall be considered to be damaged, even if no evidence of actual leakage is as yet available.
- f. Any device or material exposed to fire or fire-generated smoke shall be considered damaged. This excludes localized use of controlled welding equipment for installation.
- g. Any device or material not in compliance with the Construction Documents shall be considered damaged.
- h. Ductwork, insulation and piping which shows evidence of denting, bending or compression greater than 1/8" deep shall be considered to be damaged. Any of these items showing evidence of having walked on will be considered damaged with replacement of the affected part and a 10' length on either side of the main damaged area.

3.6 SERVICES

- A. General: Perform service on all mechanical work until acceptance of the work including oiling and greasing, adjustments, cleaning, packing of seals, and other items as recommended by equipment manufacturer in the maintenance manual specified.
- B. Air Filters:
 - 1. Do not operate air-moving equipment having air filters unless temporary filters, of minimum MERV 8 provided to all return openings and equal rating as scheduled to the equipment are in place to protect the mechanical work.
 - 2. Replace temporary filters with specified filters before final test and balance work is begun as necessary for accurate reading After completing the testing and balancing work, replace filters with new filter media as specified.
- C. Strainer: Remove, clean, and reinstall each strainer screen as specified after system have been flushed.
 - 1. Clean each strainer screen after all adjustments have been made and system has operated minimum of 24 hours, but before final test and balancing operation is started.
 - 2. Clean each strainer screen again, after final test and balance operation and before completion of project.
- D. Purge all air from water systems after each servicing. Protect all furnishings and finishes during each servicing operation, and repair or replace to original condition those damaged as result of servicing at no additional cost to the owner.
- E. Replace insulation removed or damaged after each operation.
- F. Put system in full operating condition.

3.7 START UP AND FIELD ADJUSTMENT

- A. Startup Service:
 - 1. Prior to startup, ensure that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrications, venting fan balance, controls and installed properly set relief and safety valves.

2. Start and operate all systems. Provide services of factory trained technicians for startup of major equipment and systems including boilers, fire pumps, etc.
 - B. Contractor shall be responsible to change or adjust belts, drives, pulleys, motors, impellers, as required by balancing company to achieve the desired air and water delivery in an energy efficient manor by all air handling equipment, fans and pumps. Refer to Section 230593, 233400 and 232123, 237323, and 238219.
- 3.8 CLEANLINESS
- A. After all HVAC work has been tested, commissioned and approved, the contractor shall thoroughly clean all parts of the equipment installed as part of the project. Air handlers shall contain clean filters. Piping strainers shall be clean. Exposed parts shall be cleaned of overspray, plaster, grease, oil, and other materials. Exposed rough metal work shall be brushed down to remove rust and sharp edges and surface shall be prepared to receive painter's finish, when applicable.
 - B. Clean premises of all excess construction material and debris caused by work, in accordance with Division 1. At the completion of the project, and at other times as Owner may direct, remove refuse from within and around the building.
 - C. The work of each section includes removing tools, surplus materials, debris, and rubbish from the project promptly upon completion of that portion of the work. Leave the area of work clean and free of these items.
 - D. Disconnect, clean and reconnect, whenever necessary, to locate and remove obstructions from any system. Repair or replace any Work damaged in the course of removing said obstructions at no additional cost to the Owner.
 - E. After commissioning is completed, wipe down and remove overspray paint and tape glue from grille, louver, and diffuser faces and blades, and wall-mounted sensor covers.
 - F. Clean exterior of piping, ductwork and equipment, exposed in complete structure. Remove rust, paint overspray, fireproofing overspray, plaster and dirt by wire brushing; remove grease, oil and similar materials by wiping with clean rags and suitable solvents.
 - G. Motors, Pumps, Air Moving Equipment and Other Items with Factory Finish: Remove grease, oil, paint overspray, fireproofing overspray, gypsum board mud splatters, and leave surfaces clean.

3.9 REVIEW OF CONSTRUCTION

- A. Work may be reviewed at any time by the Owner.
- B. Advise the Owner that work is ready for review at following times:
 1. Prior to backfilling buried work
 2. Prior to concealment of work in walls and above ceilings.
 3. When an area or section of work is ready for punch listing by the Owner.
 4. When all requirements of Contract have been completed.
- C. Maintain on job a set of specifications and drawings for use by Owners.

- D. The Owner will provide field observations of construction, will inform the Owner regarding progress and problems related to construction, and will endeavor to guard the Owner against defective materials and faulty workmanship. Field observations will be periodic depending upon nature of construction. The Owner does not perform an extensive or continuous inspection, is not responsible for execution of Contract Documents by Contractor, and is not responsible for construction methods, sequences, or safety precautions.

3.10 FINAL INSPECTION

- A. The Contractor shall arrange for the all authorities having jurisdiction to make final inspections and correct all defects identified.
- B. Prior to substantial completion the Contractor shall verify that the work is complete and that all incidental defects identified by the Architect/Engineer during construction have been corrected.
- C. As the work nears completion, review the requirements of the Contract Documents, inspect the work and inform all parties involved in work to be corrected or completed before the project can be deemed substantially complete.
- D. When the project is substantially complete, notify the Owner in writing of this fact, listing those items of work remaining incomplete, the reason for incompleteness, and the anticipated date that all remaining work will be completed. Carry out own final inspection and be satisfied that the work is complete. Final inspection of the project will then be scheduled by the Owner.
- E. The Owner reserves the right to cancel and reschedule the inspection in the event considerable more work remains to be completed or corrected than indicated in the written request for inspection.
- F. All items not completed or found not complying with drawings or specifications by the Owner will be identified in an inspection report by Owner.
- G. Each piece of equipment comprising part of the mechanical system shall be checked for proper lubrication, drive rotation, belt tension, control sequence and any other conditions which may cause improper equipment operation, damage to equipment or endanger personnel.
- H. Correct all items on inspection report. Make the correction and initial and date each item on the report after corrections have been completed.
- I. Verify that all defective work has been corrected before offering the system for re-inspection.

3.11 PROJECT CLOSE-OUT

- A. Prior to requesting Owner's inspection for certification of substantial completion, complete the following and list known exceptions in request:
 - 1. Obtain final inspections and approvals from all governmental jurisdictions that are required for the project.

2. Submit record drawings, maintenance manuals, warranties, and similar final record information.
3. Complete start-up, testing and demonstration of systems to the satisfaction of the Owner that the entire installation is complete, properly adjusted and is in proper operating condition.
4. Complete final cleaning requirements.
5. Complete all training requirements for Owner's Staff.
6. Complete the Commissioning processes.
7. Lubricate all equipment at completion of work. Furnish Owner with a written lubrication schedule for all equipment as specified in Division 1- Closeout Submittals. Extend grease fittings on all bearings to points of ready and easy accessibility.

B. Furnish to Owner the following:

1. Deliver spare parts, extra stocks of materials, and similar physical items to the Owner.
2. One set of any special tools required to operate, adjust, dismantle or repair any equipment of this Division. "Special Tools" means those not normally found in possession of mechanics or maintenance personnel.
3. One pressure grease gun for each type of grease required, complete with adaptors to fit all lubricating fittings on equipment.

END OF SECTION

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section. Where conflict occur between divisions, the more stringent requirement shall apply.

B. SUMMARY

1. Section Includes:
 - a. Polyphase Motors.
 - b. Single-phase Motors.
 - c. Couplings.
 - d. Guards.
 - e. Variable Frequency Motor Controllers.

- C. Motors will be specified as follows:

Motor Size	Electrical Connections	Comments
½ HP or less	120V – 1ph – 60 Hz	Preference: Direct drive with a minimum of three speed controller or ECM motors for balancing and efficiency purpose
¾ HP or more	460V – 3ph – 60 Hz (unless available service is 208/230V)	Required: premium efficiency per NEMA MG1 Table 12-12, service factor of 1:15 (unless required to be higher for smoke control), minimum power factor of 0.85 Preference: direct drive with variable frequency drive

- D. Related Sections:

1. Section 230593 - Testing, Adjusting and Balancing for HVAC.
2. Section 23 - All applicable equipment sections.
3. Controls diagrams and sequences of operations in drawings and specifications.
4. All variable frequency drives on the project to be from the same manufacturer, including VFD's that are unit mounted and installed by the equipment manufacturer. Contractor shall negotiate this in advance and review submittals for consistency prior to the submission of any product containing a variable frequency drive.

1.2 REFERENCES

- A. American Bearing Manufacturers Association:
 - 1. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
 - 2. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
- B. American National Standards Institute:
 - 1. ANSI/IEEE 112 - Test Procedure for Polyphase Induction Motors and Generators.
 - 2. ANSI/NEMA MG 1 - Motors and Generators.
 - 3. ANSI/NFPA 70 - National Electrical Code.
- C. American Society of Heating Refrigerating and Air-Conditioning Engineers:
 - 1. ASHRAE 90.1 - Energy Efficiency in the Design of Buildings.
- D. National Electrical Manufacturers Association:
 - 1. NEMA MG 1 - Motors and Generators.
 - 2. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
 - 3. NEMA FU 1 - Low Voltage Cartridge Fuses.
 - 4. NEMA ICS 7 - Industrial Control and Systems: Adjustable Speed Drives.
 - 5. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable Speed Drive Systems.
- E. Institute of Electrical and Electronics Engineers:
 - 1. IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
- F. International Electrical Testing Association:
 - 1. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.

1.3 COORDINATION

- A. All variable frequency drives on the project to be from the same manufacturer, including VFDs that are unit mounted and installed by the equipment manufacturer. Contractor shall coordinate this requirement with equipment manufacturer.
- B. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

1.4 PERFORMANCE REQUIREMENTS

- A. The contractor shall bear responsibility for ensuring that the calculations referenced in “Harmonic Mitigation” section below are performed by a qualified individual capable of modeling the effects of all the VFDs to be installed on the project. This is a performance requirement for the entire project, despite the fact that individual suppliers may choose to submit VFDs as part of their equipment packages. Any equipment submittal containing a VFD submittal will be returned as “Not Reviewed” until the overall calculation has been submitted for review.
- B. For the purposes of all calculations and measurements referencing the Institute of Electrical and Electronics Engineers Standard 519. The Point of Common Coupling (PCC) shall be the building side of the utility transformer.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures and Section 230000 – Basic Mechanical Requirements for HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.
- B. Motors:
 - 1. Product Data: Submit catalog data for each motor. Submit data in conjunction with mechanical equipment served by motors.
 - a. Loose-shipped motors: Indicate nameplate data, standard compliance, electrical ratings and characteristics, and physical dimensions, weights, mechanical performance data, and support points.
 - b. Factory-mounted motors: Indicate nameplate data, standard compliance, electrical ratings and characteristics, and mechanical performance data.
 - 2. Test Reports: Indicate procedures and results for specified factory and field testing and inspection. Data to include:
 - a. Model, catalog number and modifiers.
 - b. BHP, full load current, max KVAR for P.F. correction.
 - c. HP/RPM/Frame data, motor weight.
 - d. Guaranteed efficiency and power factor (P.F.) at 100%, 75%, 50%, and 25% load in accordance with ANSI/IEEE 112 Test Method B.
 - e. Sound power levels measured per ANSI/NEMA MG-1.
 - f. Test results verifying nominal efficiency and power factor for three phase motors larger than 5 horsepower.
 - g. NEMA certified rating, and NEMA rating of enclosure.
- C. Variable Frequency Motor Controllers:
 - 1. Product Data: Submit catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details. Also including
 - a. Dimensioned outline drawing.
 - b. Schematic diagram.

- c. Component list.
 - d. Power and control connection diagram(s).
 - e. NEMA rating of enclosure.
- 2. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
 - 3. Test Reports: Indicate field test and inspection procedures and test results.
 - 4. Manufacturer's Field Reports: Indicate start-up inspection findings.
 - 5. Harmonic Mitigation Calculations for the entire project per IEEE-519, including critical data from all VFD's on the project to justify calculations, regardless of whether they are submitted under Division 23 or not.
 - 6. Harmonic Mitigation Test Results.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Requirements for submittals.
- B. Provide final equipment submittal information with all noted corrections incorporated.
- C. Operation and Maintenance Data: Submit instructions complying with NEMA ICS 7.1. Include procedures for starting and operating controllers, and describe operating limits possibly resulting in hazardous or unsafe conditions. Include routine preventive maintenance schedule.
- D. The Owner requires manufacturers to provide BIM family objects for final as-built documentation of all equipment requiring service and/or containing motors. Motors integral to a piece of equipment shall be represented with the BIM of that equipment. Loose motors shall have a BIM provided.

1.7 QUALITY ASSURANCE

- A. Conform to ASNI/NFPA 70.
- B. UL listed.
- C. Conform to efficiency requirements of local and state energy codes.
- D. All motors shall be designed, manufactured, and tested with the latest applicable standards of NEMA, IEEE and ASTM.
- E. Refer to calculation and additional testing requirements located within Division 26 and Part 3 of this Section.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum ten years' experience.
- B. Testing Agency: Company member of International Electrical Testing Association and specializing in testing products specified in this section with minimum three years' experience.

1.9 SOURCE QUALITY CONTROL

- A. Test motors in accordance with NEMA MG 1, including winding resistance, no-load speed and current, locked rotor current, insulation high-potential test, and mechanical alignment tests.
- B. Shop inspect and perform standard productions tests for each controller.
- C. Make completed controllers available for inspection at manufacturer's factory prior to packaging for shipment. Notify the Owner at least seven days before inspection is allowed.
- D. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify the Owner at least seven days before inspections and tests are scheduled.

1.10 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided. Handle carefully to avoid damage to components, enclosure, and finish.
- C. Store in clean, dry space. Maintain factory wrapping and provide additional plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. For extended outdoor storage, remove motors from equipment and store separately.

1.11 ENVIRONMENTAL REQUIREMENTS

- A. Section 016000 - Product Requirements: Environmental conditions affecting products on site.
- B. Conform to NEMA ICS 7 service conditions during and after installation of variable frequency controllers.

1.12 WARRANTY

- A. Division 1- Execution and Closeout Requirements: Product warranties and product bonds.
- B. Motors:
 - 1. All materials, assemblies, components parts and performance and workmanship shall be guaranteed against defect, damage, or non-conformity for the period noted in Division 1.
 - 2. During this period the manufacturer shall make all necessary repairs or replacement to achieve conformity to specifications.
- C. Variable Frequency Controller:
 - 1. During this period the manufacturer shall make all necessary repairs or replacement to achieve conformity to specifications.

1.13 MAINTENANCE SERVICE

- A. Division 1– Execution and Closeout Requirements: Maintenance service.
- B. Furnish service and maintenance of variable frequency controller for one year from Date of Substantial Completion.

1.14 EXTRA MATERIALS

- A. Provide two complete sets of belts and couplings for all installed motors.
- B. Furnish two of each VFD air filter.

PART 2 - PRODUCT

2.1 MANUFACTURER

- A. In other part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 MOTORS

- A. Manufacturers:
 - 1. Manufacturer of equipment with integral motor may provide motor manufacturer of choice.
 - 2. General Electric
 - 3. Baldor – Reliance – ABB
 - 4. Westinghouse
 - 5. US Motors
- B. General Requirements:
 - 1. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.
 - 2. All motors shall be suitable for non-overbearing operation, regardless of operating conditions and capable of continuous operation at full nameplate NEMA rating standards suitable for load, duty, voltage, frequency, hazard and for service and location intended. Proof of efficiency must be provided in accordance with ANSI/IEEE 112, Test Method B.
 - 3. Refer to schedules on drawings for required electrical characteristics. Confirm with Division 26 contractor electrical voltage, phase and starting device prior to submitting motors.
 - a. Motors 3/4 hp and Larger: Three-phase motor as specified below.

- b. Motors Smaller Than 3/4 hp: Single-phase motor as specified below, except motors less than 250 watts or 1/4 hp that are equipment manufacturer's standard.
 - 4. Comply with NEMA MG 1 unless otherwise indicated.
 - 5. Design for continuous non-overbearing operation under full load in 140°F environment, with temperature rise in accordance with NEMA MG 1 limits for insulation class, service factor, hazard, and motor enclosure type.
 - 6. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
 - 7. Motor Types:
 - a. Motors for outdoor service or in wet airstreams to be totally enclosed, epoxy sealed type, fan cooled (TEFC) motors.
 - b. General purpose motor generally inside the building to be open drip-proof (ODP) motors type, 40°C environment with Class A insulation (50°C temperature rise), and rated for continuous duty under full load.
 - c. Explosion-Proof Motors when explicitly indicated in the drawings or the motor is within the airstream of product conveying exhaust system: UL approved and labeled for hazard classification, with over temperature protection.
 - d. Comply with IEEE 841 for severe-duty motors.
 - 8. Connections:
 - a. Wiring Terminations: Furnish terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated.
 - b. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.
 - c. Motors shall have a power factor of 0.95 incorporating a pre-wired capacitor if required to achieve his power factor.
 - d. Where equipment is provided with control panel it shall be single point feeder, across-the-line magnetic starter, with HOA switches and overload protection.
 - 9. Visible Nameplate: Indicating motor horsepower, voltage, phase, cycles, RPM, full load amps, locked motor amps, frame size, manufacturer's name and model number, Service Factor, Power Factor and efficiency.
- C. Single-Phase Motors:
- 1. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - a. Permanent-split capacitor.
 - b. Split phase.
 - c. Capacitor start, inductor run.
 - d. Capacitor start, capacitor run.
 - 2. Motors 1/20 HP and Smaller: Shaded-pole type.

3. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
4. Voltage: As indicated on Drawings.
5. Efficiency: Refer to Part 2.2.G of this Specification. Provide efficiencies at full load and rated voltage when tested in accordance with ANSI/IEEE 112. All motors must comply with efficiency requirements of local and state energy codes.
6. Service Factor: As scheduled in Part 2.8 of this Section.
7. Starting Torque: Exceeding one fourth of full load torque.
8. Starting Current: Up to six times full load current or more.
9. Bearings: Pre-lubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading. Motor ball bearings shall be rated for a minimum ABMA L-10 life of 200,000 hours.
10. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

D. Polyphase Motors:

1. Description: NEMA MG 1, Design B, medium induction motor.
2. Voltage: As indicated on Drawings.
3. Efficiency: Premium efficiency (as defined in NEMA MG 1) for 1HP and greater. For motors less than 1 HP refer to Part 2.2.G of this Specification. Provide efficiencies at full load and rated voltage when tested in accordance with ANSI/IEEE 112. All motors must comply with efficiency requirements of local and state energy codes.
4. Service Factor: As indicated in Part 2.2.G of this Specification for full load and rated voltage.
5. Rotor: Random-wound, squirrel cage.
6. Sound Power Levels: Conform to ANSI/NEMA MG 1.
7. Motor Controller Enclosure:
 - e. Provide the appropriate NEMA rated enclosure for the following applications:
 - 1) Indoors not in mechanical rooms: NEMA 1.
 - 2) Indoors (mechanical rooms with no water-filled piping): NEMA 12.
 - 3) Indoors (mechanical rooms with water-filled piping or in areas with hose bibbs): NEMA 3R.
 - 4) Outdoor (protected by overhand): NEMA 3R.
 - 5) Outdoors (exposed to windblown dust or water): NEMA 4R
8. Insulation System: NEMA Class F.
9. Motor Frames: NEMA Standard T-Frames of steel, aluminum, or cast iron with end brackets of cast iron or aluminum with steel inserts.
10. Thermistor System (Motor Frame Sizes 254T and Larger): Three PTC thermistors embedded in motor windings and epoxy encapsulated solid state control relay with wiring to terminal box.
11. Bearings: Provide factory sealed permanently lubricated ball bearings on roof-mounted equipment. Where permanently greased bearings are not used, provide double shielded, grease lubricated anti-friction ball bearings with grease pockets on each side for re-greasing in service. Provide inlet and outlet grease connections in

motor housings for each bearing. Bearings shall be rated for minimum ABMA 9, L-10 life of 200,000 hours.

12. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.
13. Weatherproof Epoxy Sealed Motors: Epoxy seal windings using vacuum and pressure coat windings with rotor and starter surfaces protected with epoxy enamel. Bearings shall be double shielded with waterproof non-washing grease.
14. Starting Torque: Between one and one and one-half times full load torque.
15. Starting Current: Six times full load current or more.
16. Code Letter Designation:
17. Motors 15 HP and Larger: NEMA starting Code F or Code G.
18. Motors smaller than 15 HP: Manufacturer's standard starting characteristic.
19. For motors 50 HP and larger not driven by VFD provide winding configuration suitable for star delta reduced voltage starting.
20. Power Output, Locked Rotor Torque, Breakdown or Pullout Torque: NEMA Design B characteristics.
21. Testing Procedure: In accordance with ANSI/IEEE 112, Test Method B. Load test motors to determine freedom from electrical or mechanical defects and compliance with performance data.
22. Performance testing and efficiency ratings shall be in accordance with IEEE, Test Procedure 112A, Method B. Motors shall be labeled with NEMA efficiency code letters.
23. Multispeed Motors: Separate winding for each speed.
24. Motors Used with Variable Frequency Controllers:
 - a. For motors driven by variable speed drives (VFD), motors shall be compatible with drive unit and shall include insulated motor bearings and grounded motor shafts to prevent arcing through motor bearings.
 - b. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
 - c. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - d. All motors greater than 10HP shall be inverter duty regardless of variable flow application.

E. Couplings:

1. Direct drive couplings to be flexible, self-aligning, non-lubricating type rating for 125% of load, and shall be totally enclosed with heavy gage steel guards per OSHA requirements.
2. Where belt drives are the only available option, include OSHA belt guards and motor slide rails, and coordinate with TAB contractor responsible for final belt adjustment for balancing. Provide V-belts of proper number and size, complete with the required grooved sheaves and other requisite accessories. The motors driving fans shall not be operated beyond the name plate horsepower as determined from measurement of actual current draw. These requirements equivalent to the motor and drive requirements used for smoke control fans for an international level of redundancy.
3. Belt drives:

- a. Belt drives shall be V-belt type with appropriate sheaves.
 - b. Motors 10 HP and smaller shall be provided with variable pitch sheaves and installed on motor slide rails.
 - c. Motors 15 HP and larger shall have non-adjustable drive sheave and be installed on motor slide rails.
 - d. After air balance is completed and air balance has been accepted by the Architect, change each variable pitch sheave to fixed pitch sheave. This is the responsibility of the TAB contractor.
 - e. Manufacturer: Sheaves and belts shall be Browning, Dodge, or Gates.
4. Belt drives sheaves:
- a. Sheaves shall be cast iron, machined and balanced.
 - b. Variable pitch sheaves shall be selected for mid point of equipment operating capacity.
 - c. Sheaves shall be keyed and located on shafts, with Allen head set screws. On fractional horsepower motors on NEMA frame size 48, smaller sheaves may be secured to shaft with set screws only.
5. Belt ratings:
- d. On each two belts drive, each belt shall be rated for motor nameplate horsepower rating. On three belt or greater, drive shall be rated for 150% of motor nameplate horsepower rating.

F. Guards

1. All rotating elements on equipment shall have protective devices in accordance with the California Code of Regulations Title 8, Division of Industrial Safety and General Industry Safety Orders and OSHA requirements.
 - a. Coupling guards shall completely enclose the rotating coupling and shall be constructed of heavy gage steel.
 - b. Belt guards shall totally enclose the belts and sheaves. Guards shall be fabricated of 16 gauge galvanized expanded metal sides with 70% free area, solid galvanized steel band and adequately sized galvanized angle iron frame. Outdoor belt guards shall be solid metal with stamped out louvers at top and bottom for ventilation. Adequate room for belt adjustments shall be provided. Tachometer holes with covers shall be provided for both sheaves.

G. Schedules for Compliance

1. NEMA Polyphase Motor Service Factor Schedule

HP	3600 RPM	1800 RPM	1200 RPM
1/6-1/3	1.35	1.35	1.35
1/2	1.25	1.25	1.25
3/4	1.25	1.25	1.15

1	1.25	1.15	1.15
1.5-150	1.15	1.15	1.15

2. Minimum Motor Efficiency Schedule (less than 1 HP)

Nameplate Horsepower	Motor Efficiency
1/20	40%
1/12	49%
1/8	55%
1/6	60%
1/4	64%
1/3	66%
1/2	80.0%
3/4	84.0%

2.3 ELECTRIC MOTOR STARTERS

- A. Manufacturers: there shall be only one electric motor starter manufacturer for mechanical equipment allowed on the job: to be coordinated by Division 23 Contractor.

1. Allen Bradley Co.
2. Square D.
3. General Electric
4. Or approved equal.

2.4 VARIABLE FREQUENCY CONTROLLER

- A. Variable frequency drives shall be provided on fans and motors as scheduled. Maximum speed adjustment from 60% to 100% and minimum speed adjustment from 0% to 100%. Provide Hand-Off-Auto selector switch, digital speed settings, Auto/Manual selector switch, readouts for motor speed, motor amps, motor volts, % load LED indicators for Power, Fault, and "at set speed". Provide automatic overload sensing. Provide NEMA enclosure rating as required later in the section based on installation location. Provide integral line reactors. Provide 3 sets of spare dry contacts besides the connections required for the sequence of operations as listed in control diagram.
- B. Variable frequency drive to be by a single manufacturer and shall conform to ANSI/NFPA 70.
- C. Manufacturers: there shall be only one VFD manufacturer for mechanical equipment allowed on the job: to be coordinated by Division 23 Contractor.

1. Reliance.
2. ABB.
3. Baldor.
4. Toshiba.
5. Eaton
6. Or approved equal.

- D. Variable Frequency Drives shall incorporate a DC bus inductor, 5% integral line reactors and shall produce no more than 3% Total Harmonic Distortion when operating alone to provide harmonic filtration. Variable frequency drives shall include a 12-pulse rectifier for all motors greater than 20HP and less than 50HP.
- E. Product Description: NEMA ICS 7, enclosed variable frequency controller suitable for operating indicated loads. Select unspecified features and options in accordance with NEMA ICS 7.1.
- F. The VFD shall be equipped with microprocessor-based control for three-phase induction motors and shall be of the Pulse Width Modulated (PWM) design, 6-pulse type unless otherwise noted, converting the utility input voltage and frequency to a variable voltage and frequency output via a three-step operation. Adjustable Current Source VFD are not acceptable. Insulated Gate Bipolar Transistors (IGBT's) shall be used in the inverter section. Bipolar Junction Transistors, GTO's or SCR's are not acceptable.
- G. The VFD shall limit harmonic distortion reflected onto the electrical system, that meet the total Harmonic Distortion Requirements of 5% on current and 5% on voltage per IEEE Standard 519, by utilizing means or features that are as follows:
 - 1. For motors less than 5HP, provide 5% nominal impedance integral AC 3-phase line reactor.
 - 2. For motors 5Hp to 40HP, provide a dual 5% impedance DC link reactor on the positive and negative rails of the DC bus. VFD's with saturating (non-linear) DC link reactors shall require an additional 3% AC line reactor. There shall be no automatic switching in/out of capacitors or inductors. The cancellation of harmonics shall be achieved without requiring phase shifting against other harmonic sources.
- H. Total harmonic distortion shall be calculated under worst-case conditions in accordance with the procedure outlined in IEEE standard 519-1992. Any harmonic calculations shall be done based on the kVA capacity, X/R ratio and the impedance of the utility transformer feeding the installation, as noted on the drawings, and the total system load. The calculations shall be made with the point of common coupling being the building side of the campus' utility transformer.
- I. Where shown on the drawings, variable frequency drives shall have the following features:
 - 1. All VFDs shall be rated 480V and provide microprocessor-based control of three-phase motors. The controllers shall be rated as shown on the drawings.
 - 2. VFDs for motors up to 10HP shall utilize a vector torque control strategy to regulate motor flux to optimize motor torque without the need for encoders. VFDs requiring voltage, dwell and current adjustments to achieve improved torque control are not acceptable. As a minimum the full load output current of the drive shall be equal to the equivalent motor horsepower as listed by National Electric Code Table 430-150.
 - 3. VFDs for motors larger than 10HP the minimum continuous full load output current of the drive shall be equal to 1.05 times the full load current of the equivalent motor horsepower as listed by National Electric Code Table 430-150. The continuous full load output current rating shall be based on 40°C ambient and 12 kHz switching frequency for 15 and 20 hp, 6 kHz for 30 through 100 hp, and not any lower switching frequencies. The VFDs shall run at the above listed switching frequencies and shall be programmable on over-temperature to either fold back the switching frequency to

- a minimum of 3 kHz or fold back the speed, without shutdown, until the over-temperature condition has passed.
4. The VFDs shall be of the Pulse Width Modulated (PWM) design converting the utility input voltage and frequency to a variable voltage and frequency output via a two-step operation. Insulated gate bipolar transistors shall be used in the inverter section. Bipolar transistors, GTOs and SCRs are not acceptable.
 5. The VFDs shall have an efficiency that exceeds 97% at 100% speed and load. The efficiency shall exceed 80% at 50% speed and load.
 6. The VFDs shall maintain the line side displacement power factor at no less than 0.95, regardless of speed and load.
 7. The VFDs shall have a one (1) minute overload current rating of 150%. The VFDs shall have a one (1) minute overload current rating of 150% for Constant Torque Drives. The VFDs shall have a one (1) minute overload current rating of 110% for Variable Torque drives. The VFD's shall have a 120% rated Torque of 0.5 seconds while starting. The VFD shall provide full Torque at any selected frequency from 20Hz to full speed while providing variable torque V/Hz output at reduced speed. Breakaway torque of 160% shall be available.
 8. The VFDs shall be capable of operating any NEMA B squirrel cage induction motor, regardless of manufacturer, with a load rating equivalent to the capacity of the VFDs.
 9. The VFDs shall limit harmonic distortion reflected onto the installation distribution system to a voltage and current distortion level as defined by IEEE 519 for general system applications. Harmonic attenuation shall be provided by the addition of drive line reactance. Harmonic calculations shall be provided upon request.
 10. All harmonic calculations shall be done based on the kVA capacity, X/R and impedance of the transformer supplying the VFDs as shown on the drawings and shall be calculated at the point of common coupling, the building side of the utility feeder to the facility.
 11. The VFDs shall be able to start into a spinning motor. The VFDs shall be able to determine the motor speed in any direction and resume operation without tripping. If the motor is spinning in the reverse direction, the VFDs shall start into the motor in the reverse direction, bring the motor to a controlled stop, and then accelerate the motor to the preset speed.
 12. Standard operating conditions shall be:
 - a. Incoming Power: Three-phase, 480Vac (+10% to -10%) and 60 hertz (+/-2 hertz) power to a fixed potential DC bus level. The VFD shall continue to operate with reduced output without faulting with input voltage as low as 70% of the nominal voltage and shall provide full rated output for input voltages of 90% of nominal.
 - b. Frequency stability of +/-0.5% for 24 hours with voltage regulation of +/-2% of maximum rated output voltage.
 - c. Motor slip dependent speed regulation of +/-0.5% for motors up to 10HP and motor slip dependent speed regulation of 3% (0.5% with slip compensation) for motors larger than 10HP.
 - d. Five (5) cycle carry-over during utility loss
 - e. Insensitive to input line rotation
 - f. Humidity: 0 to 95% (non-condensing and non-corrosive)
 - g. Altitude: 0 to 3,300 feet (0 to 1000 m) above sea level
 - h. Ambient Temperature:

- 1) 32°F to 122°F (0 to 50°C) for NEMA 1 and NEMA 12
- 2) 32°F to 115°F (0 to 46°C) for NEMA 3R
- 3) 32°F to 104°F (0 to 40°C) for NEMA 4

i. Storage Temperature: -4°F to 178°F (-20 to 70°C).

13. Control Functions

a. For VFDs up to 10HP programmable parameters shall be adjustable from a digital operator keypad located on the front door of the VFD. All VFD's shall have the same interchangeable customer interface keypad to allow a single programmable keypad to download information to multiple VFD's during start of procedures. Parameters shall include:

- 1) Programmable speed command (keypad, remote)
- 2) Programmable start command (keypad, remote)
- 3) Forward or reverse start, stop and digital speed control
- 4) Programmable maximum and minimum frequency limits
- 5) Programmable acceleration and deceleration times (2 each)
- 6) Programmable critical frequency avoidance lockout zones
- 7) Programmable electronic overload and torque limits
- 8) Programmable multiple attempt restart
- 9) Programmable jog and preset speeds
- 10) Programmable "Catch a Spinning Motor" function
- 11) Programmable output digital relay (2)
- 12) Programmable output analog signal
- 13) Programmable DC Injection Braking Time
- 14) Programmable PI process control
- 15) Programmable digital potentiometer.

b. For VFDs larger than 10HP programmable parameters shall be adjustable from a digital operator keypad located on the front door of the VFD. All VFD's shall have the same interchangeable customer interface keypad to allow a single programmable keypad to download information to multiple VFD's during start of procedures. Parameters shall include:

- 1) Programmable speed command (keypad, remote) with two (2) pilot lights and selector switch
- 2) Programmable start command (keypad, remote) with two (2) pilot lights and selector switch
- 3) Forward and reverse control with two (2) pilot lights and selector switch
- 4) Two (2) pilot lights to indicate display in operation or diagnosis
- 5) Two (2) pilot lights to indicate setup is in scroll or change mode
- 6) Increase/decrease buttons to change speed or setup or display or diagnose
- 7) Programmable maximum and minimum speed limits
- 8) Programmable acceleration and deceleration times (2 each)
- 9) Programmable critical frequency avoidance lockout zones (5 each)
- 10) Programmable electronic overload and torque limits

- 11) Programmable multiple attempt restart
 - 12) Programmable jog and preset speeds
 - 13) Programmable "Catch a Spinning Motor" function
 - 14) Programmable output digital relay (2)
 - 15) Programmable analog output (2)
 - 16) Programmable DC Injection Braking Time
 - 17) Full Proportional/Integral/Derivative (PID) process control built in.
14. The VFDs shall have the following system interfaces:
- a. Inputs
 - 1) Process control speed reference interface to receive either a 0-10 Vdc, 4-20 mA dc or speed potentiometer signal
 - 2) Remote mode start and stop contacts
 - 3) Remote forward/reverse contacts
 - 4) Remote preset speed contacts
 - 5) Remote external trip contact
 - 6) Remote reset contact
 - 7) Remote jog contact.
 - 8) For VFDs larger than 10HP a speed potentiometer signal and minimum of (8) programmable digital and (3) programmable analog feedback inputs with independent scaling shall be provided in addition to above listed items.
 - b. Outputs for VFDs up to 10HP
 - 1) Programmable digital relays (2) NO contact
 - 2) Form C contact to indicate protective function trip
 - 3) Two (2) programmable analog output signals.
 - c. Outputs for VFDs larger than 10HP. A minimum of two (2) discrete programmable digital outputs and two (2) programmable analog outputs shall be provided with the following available as a minimum:
 - 1) Programmable relay outputs (2) with one (1) set of Form C contacts each, selectable with the following available feature: Fault, Run, Ready, at Speed, Stopped, Current Limit, and Auto Reverse.
 - 2) Programmable analog output signals (2), selectable with the following available Features: Speed, Load, Kilowatts, Motor Voltage, Motor Amps, Line Voltage, Bus Current, and Speed Reference.
15. Monitoring and Displays: The VFDs shall have a 2-line, 16-character each display, indicating monitored functions as described in the following:
- a. Output current for each of 3 output phases
 - b. Output frequency
 - c. Motor rpm (speed)
 - d. Output voltage
 - e. Power (KW)

- f. Load
 - g. Elapsed time
 - h. Trip cause
 - i. Flash memory programmed via RS 232 port with Windows based configuration software included for advanced programming and trouble-shooting
 - j. User display functions shall be selectable from a list to avoid displaying unused functions.
16. Protection Functions: The VFD shall include the following protective features:
- a. Overcurrent protection – provide a minimum of class 20 I2t motor overload protection, which shall automatically compensate for changes in motor speed.
 - b. Overvoltage protection
 - c. Undervoltage protection
 - d. Phase loss protection
 - e. Ground fault protection
 - f. Adjustable current limit
 - g. Line-to-line and line-to-ground output short-circuit protection
 - h. Overload capability shall be 150% of the motor FLA based on the NEC ratings for 60 seconds.
 - i. DC injection braking
 - j. Overtemperature protection (VFDs for larger than 10HP motors shall run at the previously specified switching frequency. On first stage over-temperature the VFD shall be programmable to fold back the switching frequency to a minimum of 3 kHz or reduce the current limit setting automatically, without VFD shutdown. It shall automatically return to the primary settings upon cooler temperature. Second stage over-temperature shall stop the VFD).
17. Braking: DC injection braking shall be included.
18. Diagnostic Features (for VFDs larger than 10HP)
- a. Fault History -- Record and log faults in English language, most recent first, by date, time, item, and description of that item. Store up to 15 faults.
 - b. Warning History -- Record and log the last 15 warnings by date, time, item, and description of that item.
 - c. Event History -- Record and log the last 15 command events by date, time, command, and description of that command.
 - d. Trend Files -- Record 1000 msec of trend data before each of the recorded faults. Display any four (4) of eight (8) parameters both digitally and in four (4) color graphics via the Windows™-based program.
 - e. I/O Monitor -- Provide a monitor to aid in troubleshooting by showing digital I/O status.
19. Optional features to be included in VFDs:
- a. Integral input disconnect breaker with minimum AIC rating of 65,000Amps or higher as required by Division 26 shall be provided. Operating handle shall protrude through the VFD door and the disconnect device shall not be mounted on the door. The handle shall have provisions for padlocking in the OFF position. Interlocks shall prevent unauthorized opening or closing of the VFD door with disconnect handle in the ON position.

- b. AC input line current limiting fuses rated 200,000 AIC for fault current protection of AC to DC converter section
- c. Card for interface with BMS System, compatible with BacNet protocols.
- d. 120-Vac control to allow VFD to interface with remote dry contacts at a distance up to 500 feet
- e. Motor overcurrent relay to provide motor overcurrent sensing of a given level of load current
- f. Provide integral EMI/RFI power line filters to assure compliance to FCC Class A and Class B requirements.
- g. Provide IEEE C62.41 rated, factory-mounted transient voltage surge suppressor, selected to meet requirements and to coordinate with system circuit voltage.
- h. The VFD shall (at minimum) be provided with the necessary hardware to allow for the hardwiring of the following operating parameters; (1) Start/Stop, (2) Status, (3) Speed Output.

20. Harmonic Mitigation

- a. The VFD installation shall meet IEEE-519-1992 with the addition of line reactors. These line reactors shall be mounted inside the drive enclosure.
- b. All drives 7.5HP and larger shall be equipped with integral DC bus inductor to minimize harmonic distortion.
- c. Provide 5% input line reactor for all VFDs.
- d. Singularly, each VFD shall produce a maximum of 3 percent harmonic voltage distortion (THD) without additional external devices or external filters, and simultaneous operation of multiple VFDs shall not add more than 5 percent total harmonic voltage distortion and 8% total harmonic current distortion back to the bus when measured at the point of common coupling without additional external devices or external filters. The building distribution transformer(s) shall be the point of common coupling.

21. Enclosures:

- a. Provide the VFD panels with the appropriate NEMA rated enclosure for the following applications:
 - 1) Indoors not in mechanical rooms: NEMA 1.
 - 2) Indoors (mechanical rooms with no water-filled piping): NEMA 12.
 - 3) Indoors (mechanical rooms with water-filled piping): NEMA 12.
 - 4) Outdoors (Protected by overhang): NEMA 3R.
 - 5) Outdoors (exposed to windblown dust or water): NEMA 3R.
- b. Provide appropriate ventilation of VFD cabinetry to maintain ambient temperature rating of the drive based upon application. On outdoor installations appropriate ventilation shall be powered ventilation fan(s) and external 12"x12"x1" paper filter arranged so as to not allow paper filter to be exposed to rain.
- c. It is preferred that VFD's for fans within air handling units are mounted externally on the unit cabinet.
- d. All power and low voltage connections shall be through the bottom of drive cabinet through factory-provided knockouts. Input and output wiring shall be in independent conduits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013100 –Project Management and Coordination: Verification of site conditions before starting work.
- B. Verify that building environment can be maintained within the service and ambient temperature and humidity ratings required by the VFD manufacturer

3.2 INSTALLATION

A. Motors

- 1. Install in accordance with manufacturer's written installation instructions.
- 2. Install securely on firm foundation. Mount ball bearing motors with shaft in any position.
- 3. Install engraved plastic nameplates in accordance with Section 260553.
- 4. Ground and bond motors in accordance with Section 260526.

B. Variable Frequency Motor Controllers

- 1. Install in accordance with manufacturer's written installation instructions.
- 2. Install in accordance with NEMA ICS 7.1.
- 3. Verify that mounting surface for VFDs are ready to receive work. Mount VFDs on the wall or at supports in locations identified on the drawings.
- 4. Tighten accessible connections and mechanical fasteners after placing controller.
- 5. Install fuses in fusible switches.
- 6. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- 7. Install engraved plastic nameplates in accordance with Section 230553.
- 8. Neatly type label inside controller door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating. Place label in clear plastic holder.
- 9. Ground and bond controller in accordance with Section 26.
- 10. Controls installer shall provide all wiring and conduit associated with the control signals into and out of the VFD to the DDC EMS and as required for any motor control interlocks.
- 11. Coordinate with Owner on permanent storage location for O&M Manual – it may not be left within the drive cabinet.
- 12. Coordinate with control diagrams for VFD monitoring and control points, which shall be hardwired for interface to EMS. Internal modules and circuitry necessary to support this shall be provided at no additional cost.
- 13. For VFD's that must be mounted remotely, they must be installed within 30 feet of unit served. Any units with VFD's mounted more than 15 feet away or out of direct line of site shall have an auxiliary disconnect on the unit to de-energize the drive.

3.3 FIELD QUALITY CONTROL

- A. Division 1- Quality Requirements and - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.
- B. Motors
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.15.
- C. Variable Frequency Motor Controllers
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.16 and NEMA ICS 7.1.
 - 3. Perform power quality analysis per warranty requirements.

3.4 MANUFACTURER'S FIELD SERVICES

- A. VFD Start-up: Provide certified factory start-up for each drive by a factory authorized service center representative. A certified start-up form shall be filled out for each drive with a copy provided to the Owner, and a copy kept on file at the manufacturer. The following VFD start-up services are to be provided as a minimum:
- B. Service center technician shall be responsible for verifying correct installation, power and control wiring connections, starting-up the drive, and checking out for proper operation.
- C. Service center technician shall also provide all final adjustments to meet the specified performance requirements.

3.5 DEMONSTRATION AND TRAINING

- A. Provide four hours of instruction to be conducted at the project site with manufacturer's representative. Contractor to also provide two sets of VFD operation manuals for use at the training session and then provide to the Owner after completion of the session.

3.6 VARIABLE FREQUENCY DRIVE START-UP SERVICE

- A. Provide start-up commissioning of variable frequency drive and optional circuits by factory certified service technician experienced in start-up and repair services. Commissioning personnel shall be the same personnel that will provide factory service and warranty repairs at site. Sales personnel and other agents who are not factory certified technicians for drive field repair not acceptable.
- B. Include checking for verification of proper operation and installation and interface wiring to building automation system. Include as a minimum:
 - 1. Verify contractor wire terminations to VFD optional circuitry.
 - 2. Verify proper operation and reliability of VFD, motor being driven and building automation system VFD shall be compatible with Bacnet protocols.
 - 3. Provide up to one hour of Owner/operator training on operation and service diagnostics during commissioning.

4. Measure to verify proper operation on:
 - a. Motor voltage and frequency. Verify proper motor operation.
 - b. Control input for proper building automation system interface and control calibration.
 - c. Calibration check for:
 - d. Minimum speed.
 - e. Maximum speed.
 - f. Acceleration and deceleration rates.
 - g. Adjust as necessary.
5. Configure VFD for automatic restart after a power failure or after an external fault is cleared.

3.7 INDEPENDENT TESTS OF HARMONIC DISTORTION

- A. The combined run-operation of all variable speed drives shall be tested by an independent approved agency after installation, startup, balancing, and commissioning.
- B. The tests shall demonstrate that the VFD's when running together produce less than 5% Total Harmonic Distortion (THD) for voltage and 5% THD for current per IEEE-519 standards using the building side of the utility company transformer.
- C. The tests shall be run with all VFD's running, but the elevators not running. Then the test shall be run again with the elevators running along with all VFD's. Where the test shows that the whole system is unable to comply with the stated criteria, the contractor shall provide at no cost to the Owner, corrective harmonic mitigation and a set of retests to prove compliance. Any diagnostic testing performed by the Contractor in determining the primary source of the harmonics shall be borne by the Contractor as part of the corrective action and shall not be back charged to the Owner. Notify the Owner two (2) weeks prior to testing so that a witness can be present and submit test results for review.

END OF SECTION

SECTION 230516 - EXPANSION FITTINGS AND LOOPS FOR HVAC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this. Where conflicts occur between divisions, the more stringent requirement shall apply.

1.2 SUMMARY

- A. Section Includes:

1. Flexible, ball-joint, packed expansion joint.
2. Slide-joint packed expansion joints
3. Expansion compensator packless expansion joints.
4. Flexible hose packless expansion joints
5. Metal-bellows packless expansion joints
6. Rubber packless expansion joint
7. Grooved-joint expansion joints
8. Pipe loop and swing connections
9. Alignment guides and anchors

- B. Related Sections:

1. Section 230529 – Hangers and Supports for HVAC.
2. Section 230548 – Vibration, and Seismic Controls for HVAC.
3. Section 232113 – Hydronic Piping
4. Section 232300 – Refrigerant Piping

- C. The contractor is responsible for the analysis of the piping system and the subsequent installation of expansion control devices and anchorage calculations. The calculations shall be stamped and signed by a licensed professional engineer registered in the State of California

- D. Seismic and thermal expansion and anchorage of piping is explicitly the sole responsibility of the contractor.

1.3 REFERENCES

- A. American Society of Mechanical Engineers:

1. ASME B31.5 – Refrigerant Piping.
2. ASME B31.9 - Building Services Piping.
3. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
4. ASTM-F1007 – Standard Specification for Pipeline Expansion Joints of the Packed Slip Type for Marine Application
5. ASTM-F1120 – Standard Specification for Circular Metallic Bellows Type Expansion Joints for Piping Application.
6. ASTM-F1123 – Standard Specification for Non-Metallic Expansion Joints

B. American Water Works Association

1. AWWA C606 – Standard for Grooved and Shouldered Joints

C. American Welding Society:

1. AWS D1.1 - Structural Welding Code – Steel.

D. Expansion Joint Manufacturer Association

1. EJMA Standards of the Expansion Joint Manufacturer Association

E. Federal Student Aid Handbook

1. FSA NMEJ 703 – Specifications of Elastomers Used in Piping Systems Non-Metallic Expansion Joints

1.4 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures, and shall achieve as a minimum the hydrostatic test pressures listed in Section 23 21 13.

- B. Capability: Products shall absorb 200 percent of scheduled movement between anchors.

- C. Provide structural work and equipment required for expansion and contraction of piping. Verify anchors, guides, and expansion joints provide and adequately protect system.

- D. Determine system's forces and displacements associated with expansion, then design and provide expansion compensation devices, equipment and anchors. See section 23 05 29 for anchorage criteria or adjacent piping.

- E. Provide calculations by a professional mechanical engineer, licensed in the State of California substantiating that expansion compensation is designed to meet all system expansion requirements and safely accept generated forces without failure.

- F. Provide calculations by a professional structural engineer licensed in the State of California substantiating that the anchorage structure and bolts resisting the expansion are adequately sized for the duty and compatible with base building structures.

- G. Coordinate expansion requirements with the work of other trades.

- H. Provide project structural engineer of record with required loads and forces to support and restrain piping, and show anchorage calculations.

I. Expansion Compensation Design Criteria

1. Installation Temperature: 50°F for heating, 110°F for cooling piping.
2. Maximum Heating Hot Water Heating System Temperature: 210 °F.
3. Chilled Water: 40°F
4. Safety Factor: 30%

- J. All work performed under this section shall achieve as a minimum the pressure ratings required of the connected piping system. Coordinate with the designer to confirm that all work

performed under this section shall not exceed the fluid pressure drop allowances of the pump system. See Section 23 21 13 for definition of working and system pressures on the project.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures and Section 230000 – Basic Mechanical Requirements for HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.
- B. Shop Drawings: Indicate layout of piping systems, including flexible connectors, expansion joints, loops and offsets. Submit piping and expansion shop drawings and calculations stamped by a registered professional mechanical engineer.
- C. Product Data:
 - 1. Expansion Compensation and Housed Expansion Joints: Bellows material, pressure rating, temperature rating, compression and elongation allowable motion, maximum installation extension, end fitting information, pressure thrust area and forces.
 - 2. Flexible-Hose Expansion Joints: Bellows, braid and end connection materials, overall length, live length, corrugations per foot, lateral stiffness based on testing at all operating pressures, maximum temperature and pressure ratings, maximum allowable displacement due to seismic motion and thermal motion.
 - 3. Guides: Load ratings for bottom, overhead or side mounting.
- D. Samples: Submit two flexible pipe connectors: one at 3/4 inch in size, one at 1 inch in size, minimum of 12 inches long.
- E. Design Data Submittal: Indicate criteria and show calculations. Submit calculations for each anchor and alignment guide indicated to comply with performance requirements and design criteria, stamped by a registered Professional Engineer. Where a force resisting support is required, this support's design and the calculations showing that the structure can accommodate the load shall be provided by a licensed professional structural engineer in the State of California. This must be coordinated with and approved by the project structural engineers.
 - 1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, bends, and swing connections.
 - 2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
 - 3. Alignment Guide Details: Detail field assembly and attachment to building structure.
 - 4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.
- F. Welding certificates. Include welders' certification of compliance with ASME Section IX for piping welding and AWS D1.1 for welding to structural steel.
- G. Product Certificates: For each type of expansion joint, from manufacturer.
- H. Manufacturer's Installation Instructions: Submit procedures.
- I. Maintenance Data: For pipe expansion joints to include in maintenance manuals.
- J. Manufacturer's Field Reports: Indicate results of inspection by manufacturer's representative.

1.6 CLOSEOUT SUBMITTALS

- A. Section 017000 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of flexible pipe connectors, expansion joints, anchors, and guides.
- C. Operation and Maintenance Data: Submit adjustment instructions and a 6-month frequency of visual observations.

1.7 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. Steel Shapes and Plates: AWS D1.1, "Structural Welding Code - Steel."
 - 2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.
- B. Perform Work in accordance with ASME B31.5, and ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

1.8 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer.
- C. Design expansion compensating system under direct supervision of professional mechanical and structural engineers experienced in design of this Work and licensed in State of California.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Product storage and handling requirements.
- B. Accept expansion joints on site in factory packing with shipping bars and positioning devices intact. Inspect for damage.
- C. Protect equipment from exposure by leaving factory coverings, pipe end protection, and packaging in place until installation.
- D. After installation, protect the expansion joints with plastic and ensure that adjacent piping system remains capped to prevent construction debris from entering the piping system.

1.10 WARRANTY

- A. Section Division 1 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five years manufacturer warranty on products in this section.

1.11 EXTRA MATERIALS

- A. Section Division 1 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Provide a spare of each size of expansion joint provided.
- C. If lubrication is required, supply two 12-ounce containers of packing lubricant and cartridge style grease gun.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 PERFORMANCE

- A. Compatibility: Products shall be suitable for piping service fluids, materials, working pressure and temperature.
- B. Product to absorb 200% of maximum axial movement between anchors.

2.3 PACKED EXPANSION JOINTS

- A. Flexible, ball-joint, packed expansion joints.
 - 1. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Mason Industries
 - b. Advanced Thermal System, Inc
 - c. Hyspan Precision Products, Inc.
 - 2. Standards: ASME Boiler and Pressure Vessel Code: Section II "Materials", and ASME B31.9, "Building Services Piping," for materials and design of pressure containing parts and bolting.
 - 3. Materials: Carbon-steel assembly with asbestos-free composition packing.
 - 4. Design: Provide 360-degree rotation and angular deflection.
 - 5. Minimum Pressure Rating: 250 psig at 400°F.
 - 6. Angular Deflection for NPS 2 and Smaller: 30 degree minimum.
 - 7. Angular Deflection for NPS 2-1/2 and larger: 14 degree minimum.
 - 8. End Connections for NPS 2-1/2 and larger: Welded ends.
 - 9. Seal Type: Two carbon steel and graphite seals suitable for continuous operation at temperature up to 650°F.
 - 10. Internal Ball: Plated with minimum 1 mil chrome cover.
 - 11. Ball Socket: One or two piece design with integral socket/retainer.

- a. Stuffing Box: Incorporates graphite containment seals and compression seals for containment of injectable packing.
- b. Packing Cylinders: Providing packing under full line pressure with check valves to prevent blowback.

Ball Joint Pipe Size NPS	Quantity Packing Cylinders of
1-1/2	3
4	4
5	4
6	5
8	6
10	7
12	8
14	9

B. Slip-Joint Packed Expansion Joints

1. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following:
 - c. Mason Industries
 - d. Advanced Thermal Systems
 - e. Hyspan Precision Products
2. Standard: ASTM F1007.
3. Material: Carbon steel with asbestos-free PTFE packing.
4. Design: Provide internal guide and minimum of two injection ports for repacking with injectable graphite under full system pressure. Housing shall be furnished with drain ports and lifting ring. Include drip connection if used for steam piping.
5. Configuration: Single joint with base unless otherwise indicated
6. Slip Tube for sizes NPS 1-1/2 through NPS 16: Schedule 80.
7. Slip Tube for sizes NPS 18 through NPS 24: Schedule 60
8. Sliding Surface: 2 mil thick chrome finish.
9. End Connections: Flanged or weld ends to match piping system.

2.4 PACKLESS EXPANSION FITTINGS

A. Metal, Expansion-Compensator Packless Expansion Joints: NPS 3/4 through NPS 4

1. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. Mason Industries
 - b. Adsko Manufacturing LLC
 - c. Hyspan Precision Products, Inc.
2. Minimum Pressure Rating: 200 psig operating pressure and 700 psig minimum burst pressure
3. Description: Totally enclosed externally pressurized two-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve, stainless steel external shroud, two

drain plugs and lifting lug for the NPS 3 and larger. The bellows are to have operating clearance between the internal pipe sleeves and the external shrouds. Joints shall be supplied with a built in scale to confirm the starting position and operating movement.

a. Joint axial movement: 2-inch of compression and 1/2-inch of extension.

4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tabs that are removed after installation in lieu of locking bolts are not acceptable.

5. Configurations:

- a. Copper Tubing: Solder joint
- b. Steel Pipe NPS 2 and Smaller: Threaded
- c. Steel Pipe NPS 2-1/2 to NPS 4: Flanged

- 1) Compensation to be furnished with one raised fixed and one floating flange. Two fixed flanges are not acceptable.

B. Metal, Expansion-Compensator Packless Expansion Joints: NPS 2 though NPS 14

1. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following:

- a. Mason Industries
- b. AdSCO Manufacturing LLC
- c. Hyspan Precision Products, Inc

2. Pressure Ratings: 225 psig minimum operating pressure and 788 psig minimum burst pressure.

3. Description: Totally enclosed externally pressurized two-ply, stainless-steel bellows isolated from fluid flow by an internal pipe sleeve. Carbon steel shroud, two drain plugs and lifting lug for the NPS 3 and larger. The bellows are to have operating clearance between the internal pipe sleeves and the external shrouds. Joints shall be supplied with a built in scale to confirm the starting position and operating movement.

a. Joint axial movement: 4-inch of compression and 3/4-inch of extension/

4. Permanent Locking Bolts: Set locking bolts to maintain joint lengths during installation. Temporary welding tables that are removed after installation in lieu of locking bolts are not acceptable

5. End Connection Configuration: Flanged, one raised fixed and one floating flange.

C. Rubber, Expansion-Compensator Packless Expansion Joints:

1. Manufacturer: Subject to compliance with the requirements, provide compatible product by one of the following:

- a. General Rubber Corporation
- b. Unaflex
- c. Metraflex.

2. Description: Flexible spherical expansion joints shall employ peroxide cured EPDM in the covers, liners and Kevlar tire cord fractioning.

- a. Solid steel rings shall be used within the raised face rubber flanged ends to prevent pullout. Flexible cable bead wire is not acceptable. Sizes NPS 2 and larger shall have two spheres reinforced with a ductile iron external ring between spheres. Flanges shall be split ductile iron or steel with hooked or similar interlocks. Sizes NPS 3/4 to 2 may have threaded two piece bolted flange assemblies, one sphere and cable retention.
- b. Pressure Rating: Connectors shall be rated at 250 psig up to 170°F with a uniform drop in allowable pressure to 215 psig at 250°F in sizes NPS 14 and smaller.
- c. All expansion joints must be factory tested to 150 percent of rated pressure for 12 minute before shipment. Safety factors to burst and flange pullout shall be a minimum of 3/1. Expansion joints shall be installed in piping gaps equal to the length of the expansion joints under pressure.
- d. Control rods need only be used in unanchored piping locations where the manufacturer determines the installation exceeds the pressure requirements without control rods. If control rods are used, they must have 1/4-inch thick neoprene washer bushings large enough in diameter to take the thrust at 1000 psig maximum on the washer area.
- e. Submittals shall include two test reports by independent consultants showing maximum reduction of 20dB in vibration accelerations and 10dB in sound pressure levels at typical blade passage frequencies on this or a similar product by the same manufacturer.

D. Flexible-Hose Packless Expansion Joints

1. Manufacturer: Subject compliance with the requirements, provide compatible product by one of the following:
 - a. Adesco Manufacturing LLC
 - b. Hyspan Precision Products, Inc
2. Description: Manufactured assembly with inlet and outlet 120-degree elbow fittings, two flexible-metal-hose legs joined by a 60-degree elbow. Loop configuration shall be capable of plus or minus 4 inches of motion in all planes for thermal expansion and contraction or seismic motion.
3. Flexible Hose: Corrugated stainless-steel hose and braided stainless-steel sheaths. Minimum live hose lengths and number of corrugations are shown below

Pipe NPS	Size	Live Length	Corrugations per foot
3/4		15	80
1		16	
1-1/2		19	63
2		20	58
3		24	46
4		26	32
5		30	29
6		33	25
8		36	23
10		42	21
12		48	20

4. Connections:
 - a. Copper Tubing NPS 2 and Smaller: Copper-alloy fittings with threaded ends.
 - b. Steel Piping NPS 2-1/2 to NPS 12: Carbon-steel fittings with free-floating flanged ends.
5. Rated Pressure: Minimum rated pressure for flanged ends are shown below

Pipe NPS	Size	Rated Pressure at 70°F (psig)	Rated Pressure at 250°F (psig)
2		360	330
3		280	260
4		225	210
5		200	190
6		200	190
8		180	170
10		170	160
12		170	160

E. Metal-Bellows Packless Expansion Joints

1. Manufacturer: Subject to compliance with the requirements, provide comparable product by one of the following:
 - a. Adsco Manufacturing LLC
 - b. Hyspan Precision Products Inc.
 - c. Metraflx
2. Standards: ASTM F1120 and EJMA "Standards of the Expansion Joint Manufacturers Association, Inc."
3. Type: Circular, corrugated two-ply, stainless-steel bellows with external tie rods.
 - a. Joint axial movement: 2-inch
4. End Configurations: Flanged ends
 - a. Expansion joints are to be furnished with one raised fixed and one floating flange. Two fixed flanges are not acceptable.
5. Pressure Rating: 250 psig minimum operating pressure and 875 psig rated burst pressure unless otherwise indicated
6. Configuration: Single joint with base unless otherwise indicated.
7. Expansion Joints for Copper Tubing: Single-ply phosphor-bronze bellows, copper pipe ends, and brass shrouds.
8. Expansion Joints for Steel Piping: Single-ply stainless-steel bellows, steel pipe ends, and carbon-steel shroud.

F. Expansion fittings must comply with the performance requirements as follows:

1. Seismic expansion joints – maximum travel of seismic movement in each direction, and appropriate location of anchorage to the two sides of the movement joints

2. Thermal expansion of piping within the building – the maximum and minimum operating temperatures for the fluid within the piping

G. Rubber Packless Expansion Joints:

1. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following:
 - a. General Rubber Corporation
 - b. Unaflex
2. Standards: ASTM F1123 and FSA's "Technical Handbook – Non-Metallic Expansion Joints and Flexible Pipe Connectors."
3. Material; Fabric-reinforced rubber complying with FSA-NMEJ-703
4. Arch Type: Multiple arches with external control rods
5. Spherical Type: Multiple spheres with external control rods
6. Minimum Pressure Rating for NPS 1-1/2 to NPS 4: 150 psig at 220°F
7. Minimum Pressure Rating for NPS 5 and NPS 6: 140 psig at 200°F
8. Minimum Pressure Rating for NPS 8 to NPS 12: 140 psig at 180°F
9. Material for fluids containing acids, alkalies, or chemicals: EPDM
10. End Connections: Full faced, integral steel flanges with steel retaining rings.

2.5 GROVED-JOINT EXPANSION JOINTS

- A. Manufacturer: Subject to compliance with requirements, provide product by one of the following:
 1. Grinnell
 2. Victaulic
 3. Anvil International
- B. Description: Factory-assembled expansion joint made of several grooved-end pipe nipples, couplings, and grooved joints.
- C. Standard: AWWA C606, for grooved joints
- D. Nipples: ASTM A53, schedule 40, Type E, steel pipe with grooved ends
- E. Couplings: Flexible type for steel pipe dimensions. Include ferrous housing selection, EPDM gasket suitable for cold and hot water and bolts and nuts.

2.6 EXPANSION LOOPS

- A. Manufacturers:
 1. Metraflex.
 2. Hyspan.
- B. Flexible Expansion Loop
 1. Flexible loops shall consist of two flexible sections of hose and braid, two 90° elbows, and 180° return assembled in such a way that the piping does not change direction, but maintains its course along a single axis.

2. Flexible loops shall have a factory supplied, center support nut located at the bottom of the 180° return and a drain/air release plug.
3. Rating: 125 psig and 400°F.
4. Maximum compression: 3 inches.
5. Maximum extension: 2 inches.
6. Size: use pipe-sized units.
7. Application: Hydronic piping expansion. Hydronic piping seismic joint accommodation.

C. Hard Piped Expansion Loops:

1. Expansion loops shall consist of 90° elbows connected by straight length of pipe to form a “U” or “Z”.

D. Stainless Steel Bellows Type:

1. Rating: 200 psig and 400°F.
2. Maximum Compression: 2 inch
3. Maximum Extension: 1/4 inch
4. Joint: As specified for pipe joints.
5. Size: Use pipe size units.
6. Application: Steel piping 3 inch and smaller.

E. External Ring Controlled Stainless Steel Bellows Type:

1. Rating: 200 psig and 400°F.
2. Maximum Compression: 1-1/4 inch.
3. Maximum Extension: 3/8 inch
4. Maximum Offset: 1 inch
5. Joint: Flanged.
6. Size: Use pipe sized units.
7. Accessories: Internal flow liner.
8. Application: Steel piping 3 inch and larger.

2.7 FLEXIBLE NEOPRENE PIPE CONNECTORS AT PUMPS

A. Manufacturers:

1. Metraflex
2. Hyspan

B. Double Sphere, Flexible Compensators:

1. Body: Neoprene and nylon.
2. Working Pressure: 125 psi.
3. Maximum Temperature: 250°F.
4. Maximum Compression: 1-1/8 inch.
5. Maximum Elongation: 7/8 inch.
6. Maximum Offset: 1 inch.
7. Maximum Angular Movement: 15°.
8. Joint: Galvanized flanges.
9. Size: Use pipe sized units.

10. Accessories: Control rods or control cables.
11. Application: Steel piping 2 inch and larger at pump connections.

2.8 SEISMIC EXPANSION JOINTS

A. Manufacturer

1. Metraloop
2. Hyspan
3. Metraflex

B. Water Piping

1. Use flexible braided hose connectors to connect all piping at seismic joints which shall use universal joint as specified herein.
2. Anchor the pipe to the wall as detailed on the drawings and provide (3) 90° ells immediately after the flexible connector
3. The braided hose shall have threaded union connections for pipe sized 2" and under and flanged connection for pipe sizes 2 -1/2" and above. The hose shall be stainless steel braid with 150lbs connections and shall be 12" long

C. Duct

1. Use flexible duct connectors to connect all duct at seismic joints
2. Anchor the duct to the wall as detailed on the Drawings.
3. The flexible connector shall be furnished with flanges and soldered to galvanized sheet metal duct or welded to stainless steel duct and shall be 12" long.

2.9 ALIGNMENT GUIDES

A. Manufacturer: Subject to compliance with requirements, provide comparable product by one of the following;

1. Masion
2. Adsco Manufacturing
3. Hyspan Precision Products

B. Description: Carbon-steel base with holes for attachment to structure, and carbon-steel adjustable pipe support frame attached to base by interfacing stainless-steel sliding alignment guides. The guides allow for axial movement only. The adjustable support frame allows up to 4-inch of insulation thickness. A minimum of two bolted pipe clamps attach pipe to the guide.

C. Pipe Guides shall be manufactured with stainless steel wrapping the carbon steel foot where it passes through horizontal U guides similarly lined to prevent corrosion. The baseplate shall have multiple holes for bolting to beam flanges or flat surfaces. Bases may be welded in position in lieu of bolting. Height must be adjustable to accept different thickness of insulation. Guide shall be professionally load rated for bottom, overhead, side mounted, or riser positioning to provide both load bearing and guiding capabilities.

1. Axial Movement: 4-inch for NPS 3/4 to NPS 2-1/2, 5-inch for NPS 3 to NPS 12.
2. Finish: Electro galvanized.

D. Anchor Materials

1. Steel Shapes and Plates: ASTM A36.
2. Bolts and Nuts: ASME B18.10 or ASTM A183, steel hex head.
3. Washers: ASTM F844, steel, plain, flat washers.
4. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened Portland cement concrete, with tension and shear capacities appropriate for application.
 - a. Stud: Threaded, zinc-coated carbon steel.
 - b. Expansion Plug: zinc-coated steel.
 - c. Washer and Nut: zinc-coated steel
5. Chemical Fasteners: Inset-type-stud, bonding-tysstem
 - a. ASTM C881, Type IV, Grade 3, two-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.
 - a. Stud: ASTM A307, zinc-coated carbon steel with continuous thread on stud unless otherwise indicated.
 - b. Washer and Nut: zinc-coated steel.

PART 3 - EXECUTION

3.1 EXPANSION JOINT INSTALLATION

- A. Install Work in accordance with ASME B31.9 for heating hot water and the requirements of Sections 232113 for matching joint and material type to adjacent piping.
- B. Install expansion joints of sizes matching sizes of piping in which they are installed.
- C. Install metal-bellows expansion joints according to EJMA's "Standards of Expansion Joints Manufacturers Association Inc."
- D. Install rubber packless expansion joints according to FSA-NMEJ-702.
- E. Install grooved-joint expansion joints to grooved-end steel piping.
- F. Install flexible pipe connectors on pipes connected to equipment supported by vibration isolation. Refer to Section 230548. Provide line size flexible connectors.
 1. Use flexible neoprene pipe connectors for connections to pumps on vibration isolators. Ensure that piping supports are arranged to allow the appropriate vibration on the pump side of the connector.
 2. Use flexible wire braided connectors on branch connections to heat transfer equipment to allow for the device to flex in the direction of vibration. For instance, up-down vibration should be decoupled through a horizontal braided connector as these devices have no compression capabilities for vertical installation.
 3. Install flexible connectors to accommodate displacement. Install one end immediately adjacent to isolated equipment and anchor other end. Install in horizontal plane unless indicated otherwise.
- G. Install manufactured, nonmetallic expansion joints according to Fluid Sealing Associations' "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."
- H. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

3.2 PIPE BEND AND LOOP INSTALLATION

- A. Provide expansion loops as required to control expansion as determined by the calculations.
- B. Install pipe loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature. After installation remove temporary space holders as required.
- C. Connect risers and branch connections to mains with at least five pipe fittings including tee in main.
- D. Connect risers and branch connections to terminal units with at least four pipe fittings including tee in riser.
- E. For flexible loops:
 - 1. Flexible loops shall impart no thrust loads to system support anchors or building structure.
 - 2. Loops shall be installed in a neutral pre-compressed or pre-extended condition as required for the application.
 - 3. Install anchor and guide per manufacture's recommendations.
 - 4. Materials of construction and end fitting type shall be consistent with pipe material and equipment/ pipe connection fittings.
- F. Explicitly note all flexible pipe connectors and expansion loops on the as-built drawings and ensure access.
- G. Attach pipe bends and loops to anchors. Refer to section 230529.

3.3 ALIGNMENT-GUIDE INSTALLATION

- A. Install guides on piping adjoining pipe expansion fittings and loops.
- B. Attach guides to pipe and secure to building structure.
- C. Install alignment guides to guide expansion and to avoid end-loading and torsional stress.
- D. Install one guide on each side of pipe expansion fittings and loops. Install guides nearest to expansion joint not more than four pipe diameters from expansion joint.
- E. Install anchors at locations to prevent stresses from exceeding those permitted by ASME EB31.9 and to prevent transfer of loading and stresses to connected equipment.
- F. Anchor Attachment:
 - 1. Anchor Attachment to Steel Pipe: Attach by welding. Comply with ASME B31.9 and ASME Boiler and Pressure Vessel Code: Section IX "Welding and Brazing Qualifications."
 - 2. Anchor attachment to Copper Tubing: Attach with pipe hangers. Use MSS SP-69, Type 24, U-bolts bolted to anchor.
- G. Fabricate and install steel anchors by welding steel shapes, plates, and bars. Comply with ASME B31.9 and AWS D1.1.

1. Anchor attachment to steel structure member: Attach by welding.
2. Anchor attachment to concrete structure member: attach by fasteners. Follow fastener manufacturer's written instruction.

H. Use grout to form flat bearing surfaces for guides and anchors attached to concrete.

3.4 HYDROSTATIC TESTING

- A. Flexible connectors and expansion joints shall be installed prior to the hydrostatic pressure test described in Section 232113 and shall be exposed to the test pressures specified therein.

3.5 MANUFACTURER'S FIELD SERVICES

- A. Section 014000 - Quality Requirements: Manufacturers' field services.
- B. Furnish inspection services by flexible pipe manufacturer's representative for final installation and certify installation is in accordance with manufacturer's recommendations and connectors are performing satisfactorily.

END OF SECTION

SECTION 230517 - SLEEVES AND SLEEVE SEALS FOR HVAC PIPING

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.
- B. Summary
 - 1. Section includes
 - a. Sleeves.
 - b. Sleeve-seal systems.
 - c. Sleeve-seal fittings.
 - d. Grout.
 - e. Firestopping relating to HVAC
- C. Related Section
 - 1. Section 230000 – Basic Mechanical Requirements
 - 2. Section 232113 – Hydronic Piping and Specialties

1.2 REFERENCES

- A. American National Standard Institute
 - 1. ANSI B31.5 – Refrigerant Piping
 - 2. ANSI B31.9 – Building Services Piping
- B. American Society for Testing and Materials
 - 1. ASTM A53 – Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless
 - 2. ASTM C1107 – Packaged Dry, Hydraulic-Cement Grout
 - 3. ASTM D3350 – Polyethylene Plastics Pipe and Fittings Materials
 - 4. ASTM E84 – Test Method for Surface Burning Characteristics of Building Materials
 - 5. ASTM E119 – Method for Fire Test of Building Construction and Materials
 - 6. ASTM E814 – Test Method of Fire Tests of Through Penetration Firestops
- C. Underwriters Laboratories Inc
 - 1. UL 263 – Fire Tests of Building Construction and Materials
 - 2. UL 723 – Tests for Surface Burning Characteristics of Building Materials
 - 3. UL 1479 – Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 – Tests of Fire Resistance of Building Joint Systems
 - 5. UL – Fire Resistance Directory

1.3 DEFINITION

- A. Firestopping (Through-Penetration Protection System): Sealing or stuffing material or assembly placed in spaces between and penetration through building materials to arrest movement of fire, smoke heat, and hot gases through fire rated construction.

1.4 PERFORMANCE REQUIREMENTS

- A. Firestopping
 - 1. Materials: See Section 078400 for appropriate materials and installation to achieve fire ratings as noted on Drawings for adjacent construction, but not less than 1-hour fire rating.
 - 2. Surface Burning Characteristic: ASTM E84 with maximum flame spread / smoke developed rating of 25/50.
 - 3. Firestop all penetrations of fire rated assemblies, materials, and components.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings:
 - 1. Firestopping: Indicate through cross-reference to UL or WH approved details the firestopping application that maintain integrity at the services penetrations at each fire related construction.
 - 2. Firestopping Schedule: Submit schedules of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
 - 3. Engineering Judgements: For firestopping conditions not covered by UL or WH listed design, submit judgements by licensed professional engineer suitable for presentation to authority having jurisdiction for acceptance as meeting code fire protection requirements.
- C. Manufacturer's Installation Instruction: Submit preparation and installation instruction for firestopping.

1.6 QUALITY ASSURANCE

- A. Through Penetration Firestopping of Fire Rated Assemblies: ASTM E814 with 0.1 inch water gage minimum positive pressure differential to achieve fire F-Ratings and temperature T-Ratings as indicated on drawings, but not less than 1-hour.
 - 1. Wall Penetrations: Fire F-Rating as indicated on architectural drawings, but not less than 1-hour.
 - 2. Floor and Roof Penetrations: Fire F-Ratings and temperature T-Ratings as indicated on architectural drawings, but not less than 1-hour.
 - a. Floor penetration within wall cavities: T-Rating is not required.
- B. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- B. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Do not apply firestopping materials when temperature of substrate material and ambient air is below manufacturer's recommendation.
- B. Maintain this minimum temperature before, during, and for minimum 3 days after installation of firestopping materials.
- C. Provide ventilation in areas to received solvent cured materials.

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Provide pipes passing through floors, walls, partitions, roofs, or concrete beams with sleeves having internal diameter 1-inch larger than outside diameter of pipe, or of insulation on covered lines, except for sleeves connecting buildings which shall be 1-1/2 inch larger.
- B. Insulated piping or ductwork through sleeves shall have uninterrupted insulation inside sleeves or openings.
- C. Through Interior Concrete Walls, Floors, and Beams: "Adjust-to-Crete," or A.M.I., telescopic, submerged, adjustable sleeves. Pack annular space between pipe and sleeve tight with fiberglass. Seal both sides with mastic for floor sleeves.
 - 1. Where vertical pipes are exposed, extend sleeves 1 inch above finished floor except where escutcheons are required. In sprinklered areas provide water-tight joint between floor and pipe or conduit passing through it by using pipe sleeve projecting 3 inches to 6 inches above the floor in accordance with NFPA 13, caulked at the top of the sleeves with oakum.
- D. Un-insulated copper pipe through ferrous sleeves or in contact with cement or concrete: Wrap pipe with two layers of heavy plastic protective tape. Finish wrapping flush with sleeve ends.
- E. Sleeves for Pipes Through Non-Fire Rated Walls: 18 gage (1.2 mm) thick galvanized steel. Pack space between sleeve and pipe or insulation with non-shrink grout, ceramic fiber, neoprene coated rope or other approved sealant materials. Install rigid calcium silicate insert on insulated pipe.
- F. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel schedule 40 pipe.

- G. Sleeves passing through roof construction: Extend minimum 8 inches above roof, flash, and seal water-tight.
- H. Sleeves for Round Ductwork: 22-gauge galvanized steel. Sleeves for Rectangular Ductwork: 22-gauge galvanized steel. Where duct penetrations will remain exposed to view, provide polished dull chrome-plated cast brass screw flanges.
- I. Sleeve Materials:
 - 1. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.
 - 2. Galvanized-Steel Wall Pipes: ASTM A 53 / A 53M, Schedule 40, with plain ends and welded steel collar; zinc coated.
 - 3. Galvanized-Steel-Pipe Sleeves: ASTM A 53 / A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.
 - 4. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
 - 5. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

2.2 SLEEVE-SEAL SYSTEMS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Advance Products & Systems, Inc.
 - 2. CALPICO, Inc.
 - 3. Metraflex Company (The).
 - 4. Pipeline Seal and Insulator, Inc.
 - 5. Or Equal
- B. Description: Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between object and sleeve, connected with bolts and pressure plates causing rubber sealing elements to expand when tightened, provide watertight seal and electrical insulation.
 - 1. Sleeves:
 - a. Sleeves through outside walls or through slab-on-grade: Schedule 40 galvanized steel pipe with anchor and waterstop plate and 150 pound galvanized steel slip on welding flange welded at center of sleeve painted with one coat of bitumastic paint inside and outside.
 - b. Other than outside wall and slab-on-grade: Molded non-metallic high-density polyethylene sleeve (HDPE) with integral hollow, molded water-stop ring four inches larger than the outside diameter of the sleeve itself.
 - 2. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe. Model CS Century-Line sleeves by Thunderline Link-Seal.

3. Pressure Plates: Modular seal pressure plates shall molded of glass reinforced nylon. For fire and high temperature service pressure plates shall be steel with zinc dichromate coating.
4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Products & Systems, Inc. Innerlynx Modular Seal
2. CALPICO, Inc.
3. Metraflex Company
4. Pipeline Seal and Insulation, Inc.
5. Or equal

B. Description:

1. Manufactured modular mechanical seal, rubber links shaped to fit annular space between pipe and wall opening.
2. Seal Element: EPDM
3. Pressure Plate: Composite
4. Bolts & Nuts: Carbon steel with 2-part Zinc Dichromate per ASTM B633, corrosion inhibiting proprietary organic coating passes 1470 hour salt spray testing.

C. Sleeve Seal for Copper piping:

1. Type: Low Durometer
2. Seal Element: EPDM
3. Pressure Plates: Composite
4. Nuts & Bolts: Carbon steel zinc plated
5. Temperature Range: -40°F to +250°F

D. Sleeve Seal for Steel Piping

1. Type: Standard
2. Seal Element: EPDM
3. Pressure Plate: Composite
4. Nuts & Bolts: Carbon steel zinc plate
5. Temperature Range: -40°F to +250°F

E. Sleeve seal for rated wall penetration:

1. Type: UL approved for 3hrs rating
2. Seal Element: Proprietary Silicone
3. Pressure Plate: Carbon steel zinc plated
4. Nuts & Bolts: Carbon steel zine plated
5. Temperature range: 3hrs fire rating (1900°F/3hrs)

2.4 GROUT

- A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- B. Characteristics: Nonshrink; recommended for interior and exterior applications.
- C. Design Mix: 5000 psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 FIRESTOPPING

- A. Manufacturer:
 - 1. Hilti Corp
 - 2. 3M Fire Protection Products
 - 3. Pipe Shields
- B. Description: Different types of products by multiple manufacturers are acceptable as required to meet specified system description and performance requirements. Provide only one type for each similar application.
- C. General
 - 1. Furnish UL listed products for fire resistance ratings and surface burning characteristics.
 - 2. Select products with rating not less than rating of wall or floor being penetrated.
- D. Primer: Type recommended by firestopping manufacturer for specific substrates surfaces and suitable for required fire ratings.
- E. Dam Material: Permanent
 - 1. Mineral fiberboard
 - 2. Mineral fiber matting
- F. Installation Accessories: Provide clips, collars, fasteners, temporary sops or dams, and other devices required to position and retain materials in place.
- G. Bare Pipe
 - 1. All steel pipe or copper tubing penetrating fire walls or decks shall be encircled by sheet metal sleeves, minimum 24 gage, sized for maximum one inch annular spacing between pipe and sleeve. Pack spacing on each end with UL rated ceramic fiber strip insulation.
- H. Insulated Pipe
 - 1. Same as for bare pipe, but with the addition of a 360-degree cylinder of waterproofed calcium silicate insulation encasing the pipe and covered with a galvanized sheet metal shielding, all sized to extend to a minimum of one inch beyond wall or deck.

2. All insulated fire-rated wall penetration shall have the insulation shield grooved if pipe is heat traced and the groove reinforced as necessary for seismic loading.

2.6 FLASHING

- A. Make penetrations through any dampproofed and waterproofed surfaces dampproof and waterproof by appropriate means to maintain integrity of system penetrated.
- B. Flash and counterflash watertight all pipe and duct penetrations of roof and exterior walls.
- C. Metal Flashing: 26 gage thick galvanized steel.
- D. Metal Counterflashing: 22 gage thick galvanized steel.
- E. Flexible Flashing: 47 mil thick sheet butyl, compatible with roofing
- F. Caps: Steel, 22 gauge minimum, 16 gauge at fire resistant elements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive sleeves.
- B. Verify openings are ready to receive firestopping.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, duct, grease, oil, loose material, or other matter affecting bond of firestopping material
- B. Remove incompatible materials affecting bond.
- C. Install backing damming materials to arrest liquid material leakage

3.3 SLEEVE INSTALLATION

- A. Furnish and set sleeves in locations where pipes or conduit pass through floors, walls, partitions, concrete beams and roof. Assume cost for cutting, patching finishing etc. resulting from failure to accomplish this requirement. Openings shall not impair strength, function or esthetics of the work cut. Coordinate all demonstrations with architect prior to any cutting work (especially in areas of post tension concrete materials).
- B. All pipes and ducts passing through construction and framed openings shall be provided with sleeves. Piping shall not be embedded in concrete or masonry.
- C. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
- D. Exterior watertight entries: Seal with mechanical sleeve seals. Sleeves shall be provided with end caps manufactured by the sleeve manufacturer. End caps shall be provided at both ends of the sleeve to prevent deformation during the concrete pour. End caps shall

remain in place until the pipe is installed through the entry. Sleeves over 25 inches shall be provide with Cell-Cast dish modular hole forming system by the mechanical sleeve manufacturer.

- E. Set sleeve in position in forms. Provide reinforcing around sleeves.
- F. Size sleeves large enough to allow for movement due to expansion and contraction, provide for continuous insulation wrapping.
- G. Extend sleeves through floors 1-inch above finished floor level. Caulk sleeves.
- H. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with stuffing, firestopping or insulation and caulk airtight, provide close fitting metal collar or escutcheon covers at both sides of penetration.
- I. Install sleeves in concrete floors, concrete roof slabs, and concrete walls as new slabs and walls are constructed.
 - 1. Permanent sleeves are not required for holes in slabs formed by molded-PE or -PP sleeves.
 - 2. 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 above finished floor level.
 - 3. Using grout, seal the space outside of sleeves in slabs and walls without sleeve-seal system.
- J. 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 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 07 92 00 – Joint Sealants.
- K. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements for firestopping specified in Section 07 84 13 – Penetration Firestopping.

3.4 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.

C. Seal opening through non-fire rated barrier as follows:

1. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
2. Size sleeve allowing minimum of 1-inch void between sleeve and building element.
3. Install type of firestopping material recommended by manufacturer
4. Install escutcheon, floor plates or ceiling plates at penetration of non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
5. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.

3.5 INSTALLATION – FIRESTOPPING

- A. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, and other items, requiring firestopping.
- B. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
- C. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
- D. Install firestopping materials in accordance with manufacturer's instruction.
- E. Seal openings as follows:
 1. Install sleeve through opening and extending beyond minimum of 1-inch on both sides of building element.
 2. Size sleeve allowing minimum 1-inch void between sleeve and building element.
 3. Pack void with backing material.
 4. Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated

3.6 SLEEVE SEAL FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.
- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

3.7 SLEEVE AND SLEEVE SEAL SCHEDULE

- A. Use sleeves and sleeve seals for the following piping-penetration applications:
 1. Exterior Concrete Walls above Grade: Cast-iron wall sleeves.

- b. Piping smaller than NPS 6: Cast-iron wall sleeves, Galvanized-Steel-Pipe sleeves, or Sleeve-seal fittings.
 - c. Piping NPS 6 and Larger: Cast-iron wall sleeves or Galvanized-steel-pipe sleeve.
 - 2. Exterior Concrete Walls below Grade
 - d. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - e. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 3. Concrete Slabs-on-Grade
 - f. Piping Smaller Than NPS 6: Cast-iron wall sleeves with sleeve-seal system or Sleeve-seal fittings.
 - 1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - g. Piping NPS 6 and Larger: Cast-iron wall sleeves with sleeve-seal system.
 - 2) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.
 - 4. Concrete Slabs above Grade
 - h. Piping Smaller Than NPS 6: Cast Iron Sleeves with sleeve-seal system.
 - i. Piping NPS 6 and Larger: Cast Iron Sleeves with sleeve-seal system.
 - 5. Interior Concrete Partitions
 - j. Piping Smaller Than NPS 6: Cast Iron Sleeves.
 - k. Piping NPS 6 and Larger: Cast Iron Sleeves.
- 3.8 FIELD QUALITY CONTROL
 - A. Inspect installed firestopping for compliance with specifications and submitted schedule.
- 3.9 CLEANING
 - A. Clean adjacent surfaces of firestopping materials.
 - B. Remove equipment, materials and debris, leaving area in undamaged, clean condition
 - C. Clean all surfaces adjacent to sealed holes and joints to be free of excess firestop materials and soiling as work progresses.

3.10 PROTECTION OF FINISHED WORK

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 230518 – ESCUTCHEONS FOR HVAC PIPING

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.
- B. Summary: Section includes
 - 1. Escutcheons.
 - 2. Floor plates.

1.2 SUBMITTALS

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

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. Subject to compliance with the requirements, provide product by one of the following
 - 1. Ferguson
 - 2. or equal

2.2 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.
- D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
- E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.

2.3 FLOOR PLATES

- A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.
- B. Split-Casting Floor Plates: Cast brass with concealed hinge.

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 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 or split-plate, stamped-steel type with concealed hinge.
 - 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 Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
- 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.
 - 2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

- A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section. Where conflicts occur between divisions, the more stringent requirement shall apply.
- B. Summary
 - 1. Section includes
 - a. Pipe hangers and supports
 - b. Insulated pipework supports
 - c. Pipe guides
 - d. Hanger rods
 - e. Inserts
 - f. Expansion anchors
 - g. Forced steel channel
 - h. Flashing
 - i. Equipment curbs
- C. Related Sections:
 - 1. Section 230548 – Noise, Vibration, and Seismic Controls for HVAC.
 - 2. Section 230700 – HVAC Insulation.
 - 3. Section 232113 – Hydronic Piping.
 - 4. Section 233100 – HVAC Ducts.
 - 5. Architect's installation requirements for roof flashing installation.

1.2 REFERENCES

- A. American Society of Mechanical Engineers:
 - 1. ASME B31.5 – Refrigeration Piping
 - 2. ASME B31.9 - Building Services Piping.
- B. American Society for Testing and Materials:
 - 1. ASTM F708 - Standard Practice for Design and Installation of Rigid Pipe Hangers.
- C. American Welding Society:
 - 1. AWS D1.1 - Structural Welding Code – Steel.
- D. FM Global:
 - 1. FM - Approval Guide, A Guide to Equipment, Materials & Services Approved By Factory Mutual Research For Property Conservation.

- E. Manufacturers Standardization Society of the Valve and Fittings Industry:
 - 1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
 - 3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.
- F. Underwriters Laboratories Inc.:
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL 2079 - Tests for Fire Resistance of Building Joint Systems.
 - 5. UL - Fire Resistance Directory.

1.3 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."

1.4 PERFORMANCE REQUIREMENTS

- A. Hangers and Supports shall be designed by a professional structural engineer in the State of California who is hired by the Contractor to meet the anchorage requirements of the Building Code. Design shall be submitted with signed calculations provided for review by the Owner and the building's Structural Engineer prior to installation of inserts or pouring of concrete. All responsibility for design and installation of supports and structural modifications necessary to accommodate the supports is borne by the Contractor. The point loads at all locations where the supports attach to steel or concrete structure shall be identified in a combined submittal managed by the General Contractor to demonstrate all super imposed loads from all suspended elements so that the building structural engineer can review if the structure is adequate for the loads within the design allowance. Total load tributary to a girder not to exceed values in the structural loading plans. In the event that the building structure cannot take the stated point, load, the contractor is responsible at no cost to the project for redesign of the support system to spread the load.
- B. Properly support all material, equipment and apparatus. Provide minimum safety factor per CBC requirements, based on ultimate tensile or compressive strength, as applicable, or material used. Turnbuckles and rod couplings capacity not less than attached rod. Calculate with equipment and piping full of water.
- C. Where anchorage requires attachment to structural steel, a design shall be submitted for review by the structural engineer.
 - 1. Structural steel shall not be loaded eccentrically.
 - 2. The anchorage design engineer shall propose the stiffener or other structural stiffening necessary to accommodate the hangar.
 - 3. Where the size of the proposed anchorage requires a transfer plate, this plate shall be designed by the anchorage design engineer.

4. If the structural engineer in any way indicates that proposed design would exceed the local capacity of the structure, the contractor bears full responsibility for redesign of the proposed support at no cost to the project.
- D. Where anchorage is to existing or new already cured concrete, limitations on inserts and anchors is as follows:
1. Existing slab is assumed to be 3000 psi strength, unless there is proof otherwise from testing. Where imposition of a hanger support requires not only structural strengthening, but also causes the owner to question the building's capacity to accommodate the load, the contractor shall bear the cost of time and materials for the owner to review and analyze the effect of imposed loading.
 2. Slab is assumed to be 4-inch thick unless there is proof otherwise. Thickness may vary depending on location in the building. Contractor to verify slab thickness prior to installation. Expansion anchors shall penetrate no more than 2-inch maximum and be placed with the structural engineer's approval.
 3. Limit embedment depth to prevent blowout of concrete on opposite side. Embedment depths shall be appropriate to thickness and strength of concrete.
 4. No powder-driven fasteners shall be allowed
 5. No epoxy anchors shall be used.
- E. In new slabs, inserts shall be used whenever possible. Expansion anchors will be allowed on a case-by-case in the event that an insert is mis-located. The area must be ferro-scanned with results submitted for review by the structural engineer for approval of drilling.
1. In new post tension slabs, very little post construction drilling will be allowed. Inserts and sleeves must be coordinated prior to pour.
 2. Installation of anchors after the concrete is poured can be considered for use throughout in new slabs with the structural engineer's review if a current ICCReport is available for the proposed anchor and the proposed specific use.
- F. Based on the Building type the following factors shall be used:
1. Seismic Restraint Loading:
 - a. Applicable Code: LABC 2014 / CBC 2019 with reference to ASCE 7-16.
 - b. Design Values as specified: per code and via site specific seismic study by project Geotechnical Engineer
 - 1) Component Importance Factor: 1.00, and 1.5 for Fire Life Safety Systems (per ASCE 7-16 Chapter 13).
 - 2) Component Response Modification Factor, R_p : (per ASCE 7-16 Table 13.6.1).
 - 3) Component Amplification Factor, a_p : (per ASCE 7-16 Table 13.6.1).
 - c. Design Spectral Response Acceleration at Short Periods (0.2 Second):

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures and Section 23 00 00 – Common Work Results for HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.
- B. Note compliance with all regulatory agencies and seismic regulations on submittals. Hangers and Supports shall be designed by a professional structural engineer in the State of California.
- C. Shop Drawings:
 - 1. Hangers and Supports:
 - a. Indicate system layout with location of all hangers and supports cross referenced by type and point load. Locations shall include dimensions from gridlines, walls or floors. Provide a detail for each hanger type proposed. Include manufacturer's model number or equipment reference on each detail. Provide a reference code for each hanger type that cross-refers to system shop drawings. Provide the point load on the structure in each support location.
 - b. Provide details showing hangar configuration, anchorage and modifications to existing structure (as necessary).
 - 2. Wherever hangers and supports impose a point load greater than 300 lbs. the shop drawings shall include details of support and anchorage spacing off of known building reference gridlines.
- D. Product Data:
 - 1. Hangers and Supports: Submit manufacturers catalog data including hanger load capacity, stamped detail drawings, bracing/load tables or individual hanger calculations to establish loads at each point.
 - 2. Anchorage: Based on the anticipated hangar loads, provide catalog data in concrete on the anchor support of the hangar accessories. If inserts are used, provide evidence of load capacity, installation instructions, and proof of compatibility with structural elements.
 - 3. Anchorage to structural steel: Based on anticipated hangar loads, provide catalog data on the anchor support of the hanger, including load capacity local loading of steel, method of attachment, and proof of available strength in the structural system.
- E. Design Data: Indicate load carrying capacity of trapeze, multiple pipe, and riser support hangers. Indicate calculations used to determine load carrying capacity of trapeze, multiple pipe, and riser support hangers. Submit calculations stamped by a registered California professional structural engineer.
- F. Manufacturer's Installation Instructions: Hangers and Supports: Submit special procedures and assembly of components.

1.6 QUALITY ASSURANCE

- A. Surface Burning Characteristics: 25/50 flame spread/smoke developed index when tested in accordance with ASTM E84.

- B. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing Products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience and approved by manufacturer.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 016000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification.
- C. Protect from weather and construction traffic, dirt, water, chemical, and damage, by storing in original packaging.

1.9 WARRANTY

- A. Division 1- Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 ROOF CURBS

- A. Manufacturers:
 - 1. Manufacturer of the supported equipment if equipment-specific curbs are available.
 - 2. Pate
 - 3. Thybar
- B. Equipment type is only for installations not requiring vibration isolation in the curb. Refer to section 230548 for vibration isolated roof curbs.
- C. Fabrication: Welded 18 gage galvanized steel shell and base, mitered 3 inch cant, variable step to match roof insulation slope as necessary, 1-1/2 inch thick insulation, factory installed wood nailer.

- D. Refer to drawings for height requirements.

2.3 PIPE HANGERS SUPPORTS

A. Manufacturer

1. Superstrut
2. Shaw Pipe Shields Inc
3. Tolco
4. Unistrut
5. B-Line
6. Anvil

- B. Conform to ASME B31. 1 and ASME B31. 9, ASTM F708, MSS SP58, MSS SP69, and MSS SP89.

- C. All HVAC piping supports shall use pre-insulated pipe support inserts of calcium silicate, including pre-insulated riser clamps.

- D. For support from above, clevis hangers with pre-insulated pipe supports shall be used for singly supported piping for pipe sizes up to and including 4" diameter piping.

1. For support from above, trapeze hangers with pipe clamps for multiple piping smaller than 4" in diameter.
2. Roller supports shall be used for all piping sized 6" or larger on heating hot water piping, whether singly supported or on trapeze hanger.
3. Vertical supports shall be pre-insulated steel riser clamps.
4. For support from a wall or floor, adjustable pipe saddles shall be used with stands or independent formed steel channel support structure as necessary.
5. Anchorage of piping to take account of any building expansion joint or base isolation plane.
6. External Support/Hangers Manufacturers: PipeShields/Piping Technology & Products, Grinnel, Unistrut Tolco, ISAT, Dura-Block or equal.
7. Pre-insulated pipe support manufacturer: PipeShields or equal
8. All insulated piping shall use load-rated insulated pipe supports, including both horizontal and vertical installations. It is not acceptable to have a pipe clamp compressed around a calcium silicate insert for vertical riser configurations, rather a device designed to directly clamp to the pipe and yet provide insulative value, such as PipeShields E2100, shall be used. All insulated pipe support inserts shall be sized to match the external dimensions of the pipe and shall incorporate an external sheet metal rigid hanger shield with a minimum of 6" long metal sleeve for piping up to 6" diameter and 12" long metal sleeve for sizes above that, centered on the hanger to spread the support's point load without crushing the insulation.
9. Piping support shall include copper plated supports with resilient stand-offs for all copper piping to prevent cathodic degradation, unless insulation or a calcium silicate insert is used at the hanger location.
10. All pipework shall be supported in accordance with SMACNA Guidelines for Seismic Restraint of Mechanical Systems and part of an approved seismic restraint system stamped by a licensed structural Engineer in the State of California.

11. Provide seismic bracing per latest applicable codes and SMACNA guidelines for all piping systems and HVAC equipment suspended more than 12" from the structural support system above. Seismic anchorage shall not interfere with the functioning of the vibration isolators.
12. Provide clevis hangers where single pipe is run alone or trapeze hangers wherever there are more two pipes traveling along the same path.
13. See Section 230548 on vibration and seismic controls for piping required to be vibration isolated.
14. All welding to structural steel shall be performed by a tradesman certified under AWS D1.1.
15. All locations of penetrations of concrete or steel structure, or attachments to such structures which has not been explicitly approved through general guidance notes on structural drawings shall be submitted to the structural engineer for a case-by-case review.

E. Corrosion Protection

1. The base material for all hangers and supports shall be as detailed below. Each base material shall be electro galvanized. Products with other final finishes shall not be acceptable.
2. All pipe supports shall be painted with zinc-based paint where the original plating has been removed due to welding, threading, or scraping.

F. Insulated Pipe Hangers and Supports (Except Vertical Risers)

1. Manufacturers:
 - a. Shaw Pipe Shields, Inc.
 - b. Tolco.
 - c. Mason West.
 - d. B-Line.
 - e. Clemente.
2. Inserts
 - a. Hangers and supports shall fit outside of all pipe insulation and insulation inserts.
 - b. Inserts shall be calcium silicate insulation treated with water repellant with galvanized steel shield per ASTM A-653.
 - c. All insulated pipe inserts shall be load rated. Load ratings shall be established by pipe insert manufacturer based upon testing and analysis in conformance with the latest edition of the following standards: ASME B31.9, MSS SP-58, MSS SP-69 and MSS SP-89.
 - d. Shield lengths and gauges shall also be per manufacturer's recommendations, with a minimum length of 12 inches centered on the hangar.
3. Hangers:
 - a. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, clevis.
 - b. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Larger: Carbon steel, adjustable, clevis.

- c. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
 - d. Hangers for All Pipe Sizes 6 inches (150 mm) and Larger: Adjustable steel yoke, cast iron roll, double hanger.
 - 4. Gripple Hangers- allowed for copper piping less than 3" diameter:
 - a. Cable: Galvanized high tensile steel cable of diameter necessary to support load in tension.
 - b. Gripple Fastener: Zinc Housing, stainless steel spring and screws, wedge of sintered steel hardened to min. 56 Rockwell C, sized to match load required.
 - c. Provide with felt lining if supporting bare copper pipe.
 - 5. Trapeze:
 - a. Multiple Pipes Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - b. Multiple Pipes Trapeze Hangers for Pipe Sizes 6 inches (150 mm) and Larger: Steel channels with welded spacers and hanger rods, cast iron rollers for Hot piping.
 - 6. Wall:
 - a. Adjustable pipe saddles shall be used with stands or independent formed steel channel support structure as necessary.
 - b. Wall Support for Pipe Sizes 3 inches (76 mm) and Smaller: Cast iron hooks.
 - c. Wall Support for Pipe Sizes 4 inches (100 mm) and Larger: Welded steel bracket and wrought steel clamp.
 - d. Wall Support for Pipe Sizes 6 inches (150 mm) and Larger: Welded steel bracket and wrought steel clamp with adjustable steel yoke and cast iron roll.
 - 7. Floor:
 - a. Adjustable pipe saddles shall be used with stands or independent formed steel channel support structure as necessary.
 - b. Floor Support for Pipe Sizes 4 Inches (100 mm) and Smaller: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - c. Floor Support for Pipe Sizes 6 inches (150 mm) and Larger: Adjustable cast iron roll and stand, steel screws, and concrete pier or steel support.
- G. Insulated Pipe Supports (Vertical Risers)
 - 1. Manufacturers:
 - a. Pipe Shields, Inc. Series E.
 - 2. Vertical supports shall be pre-insulated steel riser clamps.
 - 3. Insulated riser support shall allow for proper support with no metal-to-metal contact.
 - 4. Insulated pipe supports shall be supplied and installed by the Mechanical Contractor on all insulated pipe risers. Calcium Silicate insulation treated with water repellent with galvanized steel jacket to ASTM A-653.

5. All insulated pipe supports shall be load rated. Load ratings shall be established by pipe support manufacturer based upon testing and analysis in conformance with the latest edition of the following codes: ASME B31.9, MSS SP-58, MSS SP-69 and MSS SP-89.

2.4 PIPE GUIDES

A. Manufacturers:

1. Anvil.
2. B-line.
3. Tolco.

B. Sizes suitable to receive insulation.

2.5 HANGER RODS

A. Mild steel Electroplated threaded both ends, threaded on one end, or continuous threaded.

2.6 CONCRETE INSERTS

A. Manufacturers:

1. Hilti HCI-MD.
2. Simpson.
3. Totco.
4. Mason.

B. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

C. Inserts: Carbon steel, cast-in type with internal thread and zinc yellow chromate coating; size inserts to suit threaded hanger rods.

2.7 EXPANSION ANCHORS

A. Manufacturers:

1. Hilti.
2. Or Equal

B. Provide evidence of ICBO test number for use in seismic zones.

C. Use of expansion anchors is to be limited to those locations where allowed by the Structural Engineer.

2.8 FORMED STEEL CHANNEL

A. Manufacturers:

1. Unistrut Corp.

2. Tolco.
3. B-Line Systems.

- B. Product Description: Galvanized 12 gage (2.8 mm) thick steel, structural tube or channel. With holes 1-1/2 inches (38 mm) on center. Size based on contractor's structural engineer's calculation for support of load.

2.9 SAFETY HANGER WIRES

- A. For mechanical units to be mounted on suspended-grid ceiling systems and weighing less than 56 pounds per unit, furnish and install safety hanger wires, but not connect, as work under Division 09, and to meet requirements as referenced. This does not apply to diffusers, which may be connected to the ceiling grid system via Cady clips.
- B. In advance of ceiling hanger-wire work, provide to jobsite layouts or instructions necessary for proper installation of safety wires.
- C. As part of Work under this Division 23 – Heating, Ventilating, and Air-Conditioning (HVAC):
1. Connect safety wires to mechanical equipment.
 2. For diffusers and equipment units weighing 56 pounds or more, provide approved hangers as required by the California Building Code.

2.10 FLASHING

- A. Make penetrations through any dampproofed/waterproofed surfaces dampproof/waterproof by appropriate means to maintain integrity of system penetrated, as directed by the roofing installer or waterproofing installer's requirements. Includes penetrations caused by hangers suspended off such surfaces.
- B. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013100 –Project Management and Coordination: Verification of existing conditions before starting work.
- B. Verify openings are ready to receive sleeves.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter affecting bond of firestopping material.
- B. Remove incompatible materials affecting bond.
- C. Install backing damming materials to arrest liquid material leakage.
- D. Do not use powder-actuated anchors.

- E. Obtain permission from Architect/Engineer before drilling or cutting structural members.

3.3 INSTALLATION – CONCRETE INSERTS

- A. Install concrete inserts for placement in concrete forms.
- B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
- C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe 4 inches (100 mm) and larger.
- D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- E. Where inserts are omitted accidentally, expansion anchors may be used with the location-specific approval of the structural engineer.

3.4 INSTALLATION - PIPE HANGERS AND SUPPORTS

- A. Install in accordance with ASME 31.9, ASTM F708, MSS SP 58, MSS SP 69 and MSS SP 89.
- B. Penetrations: Contractor shall provide a field mock-up of one typical wall penetration and one typical ceiling penetration with escutcheon to represent the visual impact in exposed-to-view zones. These shall be reviewed and approved by the Architect and Owner. Prior to conducting this mock-up, the Contractor shall submit product, system and installation details for all trades involved. The submittal shall clearly note the assemblies to be used in this project.
- C. Prepare all hangers to accept vibration isolation as per 230548 – Vibration and Seismic Controls for HVAC Piping and Equipment.
- D. Use properly manufactured supports throughout. Do not use make-shift materials such as wire, tape, wood blocks, etc. Pipe supports shall not be permanently affixed to the carrier pipe and shall not come into direct contact with the carrier pipe.
- E. Do not cut or weld to any structural steel without permission of structural engineer.
- F. Design hangers for pipe movement and removal or equipment without disengagement of supported pipe.
- G. Install pipe rollers for trapeze supported heating hot water pipe that is subject to expansion and contraction, as per section 2.3.
- H. Insulated pipe supports shall be supplied and installed on all insulated pipe and tubing. Pipe supports for uninsulated piping and tubing shall also be supplied and installed.
- I. On hot pipe, apply three-inch wide vapor barrier tape or band over the butt joint.
- J. All insulated pipe supports shall be load rated. Load ratings shall be established by the pipe support manufacturer based upon testing and analysis in accordance with the latest edition of the following codes: ASME B31.9, MSS SP-58, MSS SP-69 and MSS SP-89.

- K. All insulated supports and anchors shall be installed according to the manufacturer's installation instructions. All insulated supports shall be from the same manufacturer. No insulation methods that encapsulate hangers along with carrier pipes are acceptable.
- L. Prime coat exposed steel hangers and supports. Refer to Section 09 90 00. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- M. Provide clearance in hangers and from structure and other equipment for installation of insulation.
- N. Adjust each hanger to carry its proper share of load.
- O. Install additional supports or braces if, during test or normal operation, piping should sway, crawl or vibrate. Piping shall be immobile.
- P. Support piping below any ductwork from wall or trapeze with hanger rods outside of ductwork.
- Q. Support piping including valves, etc., independently of equipment; no piping weight or stress due to expansion, construction to be transmitted to equipment. Note that valves within pre-fabricated coil valve kits do not need to be independently supported – support of the kit is sufficient. Contractor is responsible for proper alignment of piping at equipment in all conditions (maximum hot to minimum cold); install anchors, guides, bracing and spring supports as required. Flexible connections, expansion joints' deflections shall be always within allowable limits. Do not install piping at equipment until inspected for alignment.
- R. Pre-insulated pipe supports for vertical riser installations shall be installed while the pipe is being erected.
- S. Trapeze suspension (trapeze hangers may be used for parallel lines if pipes pitch same direction): Size channel assembly in accordance with manufacturer's published load ratings. Deflections not to exceed 1/360 of a span.
- T. Supports from wall shall be steel brackets, hooks, clamps attached to wall structure with anchor bolts. Isolate pipe supported by clamps or hooks from supports and building construction with felt. Clamps shall not anchor piping, unless anchoring is required.
- U. Install riser clamps at each floor. Install metal channel intermediate supports midway between riser clamps if required to accommodate the gravity load of the piping.
- V. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
- W. Support riser piping independently of connected horizontal piping.
- X. Provide felt-lined copper plated hangers and supports for bare copper or metal piping.
- Y. Pipe Hanger Spacing:
 - 1. Install hangers with minimum 1/2 inch (13 mm) space between finished covering and adjacent work.

2. Place hangers within 12 inches (300 mm) of each horizontal elbow.
3. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.
4. Support vertical risers at their bases and at each floor minimum. Copper piping less than 1-1/2 inch diameter and steel piping less than 3/4-inch diameter shall have one intermediate support between floors.
5. Support every pipe branch over three feet long.
6. Support any cast-iron piping with no fewer than two supports each section and within 18 inches from both sides of each joint. Maximum 5 foot intervals except for pipe exceeding five foot length, provide supports at intervals equal to pipe length but not exceeding ten feet.
7. Install hanger within 12 inches of each 90 degree change of direction.
8. Support refrigerant piping within six feet of equipment and within two feet of each bend or angle.
9. Support horizontal metal piping as follows:

Pipe Size Inches (mm)	Copper		Schedule 40		Cast Iron	
	Maximum Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)	Maximum Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)	Maximum Hanger Spacing Feet (m)	Hanger Rod Diameter Inches (mm)
3/4 (20)	5 (1.5)	3/8 (9)	7 (2.1)	3/8 (9)	10 (3)	3/8 (9)
1 (25)	6 (1.8)	3/8 (9)	7 (2.1)	3/8 (9)	10 (3)	3/8 (9)
1-1/2 (38)	8 (2.4)	3/8 (9)	9 (2.7)	3/8 (9)	10 (3)	3/8 (9)
2 (50)	8 (2.4)	3/8 (9)	10 (3)	3/8 (9)	10 (3)	3/8 (9)
3 (75)	10 (3)	1/2 (13)	12 (3.7)	1/2 (13)	10 (3)	1/2 (13)
4 (100)	12 (3.7)	1/2 (13)	14 (4.3)	5/8 (15)	10 (3)	1/2 (13)
6 (150)	14 (4.3)	5/8 (15)	17 (5.2)	3/4 (19)	10 (3)	3/4 (19)
8 (200)	16 (4.9)	3/4 (19)	19 (5.8)	3/4 (19)	10 (3)	3/4 (19)

3.5 INSTALLATION - EQUIPMENT BASES AND SUPPORTS

- A. Provide housekeeping pads of concrete, minimum 3-1/2 inches (87 mm) thick and extending a minimum of 6 inches (150 mm) beyond supported equipment. These shall be coordinated with the design build anchorage scheme to accommodate anchor bolt edge distance requirements. Refer to Section 03 30 00.
- B. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment.
- C. Construct supports of steel members or formed steel channel. Brace and fasten with flanges bolted to structure.

- D. Provide rigid anchors for pipes after vibration isolation components are installed. Refer to Section 230548.

3.6 INSTALLATION - FLASHING

- A. Provide flexible flashing and metal counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.
- B. Provide acoustical lead flashing around ducts and pipes penetrating equipment rooms for sound control.
- C. Provide curbs for roof installations 14 inches (350 mm) minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing to equipment and lap base flashing on roof curbs. Flatten and solder joints.
- D. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.7 CLEANING

- A. Division 1- Execution and Closeout Requirements: Requirements for cleaning.
- B. Remove equipment, materials and debris, leaving area in undamaged, clean condition.

3.8 PROTECTION OF FINISHED WORK

- A. Division 1- Execution and Closeout Requirements: Requirements for protecting finished Work.
- B. Protect adjacent surfaces from damage by material installation.

END OF SECTION

SECTION 230548 - NOISE, VIBRATION, SEISMIC CONTROL FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section.
- B. SUMMARY
 - 1. This Section includes the following:
 - a. Bases.
 - b. Vibration isolators.
 - c. Seismic bracing.
 - d. Duct silencers.
 - e. Ductwork lining.
 - f. Acoustically rated flexible ductwork
- C. Related Sections:
 - 1. Section 033000 – Cast-In-Place Concrete.
 - 2. Section 079000 – Joint Protection.
 - 3. Section 089119 – Fixed Louvers.
 - 4. Section 230000 – Basic Mechanical Requirements
 - 5. Section 230516 – Expansion Fittings and Loops for HVAC.
 - 6. Section 230529 – Hangers and Supports for HVAC.
 - 7. Section 230593 – Testing, Adjusting, and Balancing for HVAC.
 - 8. Section 233300 – Air Duct Accessories.
 - 9. Section 233100 – HVAC Ducts.
- D. General Requirements: Contract shall provide vibration and seismic support as noted and documented in this section and contract document.
 - 1. Provide duct silencers based on the sizes, lengths and acoustic performance as shown in the schedules.
 - 2. Equipment sound data is based on the scheduled equipment/fan types with maximum inlet/outlet sound power levels as shown in the schedules. Scheduled data represents a maximum no tolerance not to exceed criteria set for the equipment.
 - 3. Vibration isolation for fans will be unrestrained spring isolators with seismic snubbers for floor mounted equipment and spring isolators with slack cable seismic bracing for ceiling hung equipment as scheduled.
 - 4. All duct greater than 24 inches within air handling plant rooms shall be supported using spring supports.
 - 5. Piping within mechanical rooms or within a 50-foot distance of the fluid-moving pump (whichever is greater) to be provided with pipe vibration hangers. This does not apply to condensate drain pumps.
 - 6. All vibration isolators to have verifiable deflection load characteristics and should be operate in the liner portion of their deflection curve.

7. All mountings used outdoors to be hot dipped galvanized.
- E. Provide seismic bracing per latest applicable codes and SMACNA guidelines for all piping systems and HVAC equipment. Seismic anchorage shall not interfere with the functioning of the vibration isolators.
- F. See 230529 Hangers and Support for limitations on the use of inserts and expansion anchors. Expansion bolts Hilti Kwik-Bolt III is the only know device approved for use in seismic applications for hanging loads.
- G. Duct lining shall only be used where it is noted in the drawings and deemed by the acousticians to be unavoidable. Duct lining shall meet the current flame spread and smoke developed test ratings to ensure compliance with the Mechanical Code. Additionally, preference is for Ductmate polyarmor or fibrous lining covered with Tedlar and perforated metal plate as required to prevent fibers from entering the airstream. Internal duct lining is to be avoided in general and specifically in supply ducts. Return transfer boots may use 1" thick Ductmate Polyamor, as can duct in meeting rooms.
- H. Flexible connectors shall be used at each fan connection to duct work. See 233300.
- I. Flexible connectors shall be used at each pump connection to pipework. See 230516

1.2 REFERENCES

- A. Air Movement and Control Association International, Inc.:
 1. AMCA 300 - Reverberant Room Method for Sound Testing of Fans.
 2. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data.
 3. AMCA 302 - Application of Sound Loudness Ratings for Non-Ducted Air Moving Devices.
 4. AMCA 303 - Application of Sound Power Level Ratings for Ducted Air Moving Devices Recommended Typical dBA Calculation.
 5. AMCA 500-D testing for damper rating.
- B. American National Standards Institute:
 1. ANSI S1.1 - Acoustical Terminology (Including Mechanical Shock and Vibration).
 2. ANSI S1.4 - Sound Level Meters.
 3. ANSI S1.8 - Reference Quantities for Acoustical Levels.
 4. ANSI S1.13 - Methods for the Measurement of Sound Pressure Levels in Air.
 5. ANSI S12.1 - Preparation of Standard Procedures to Determine the Noise Emission from Sources.
 6. ANSI S12.36 - Survey Methods for the Determination of Sound Power Levels of Noise Sources.
- C. Air-Conditioning and Refrigeration Institute:
 1. ARI 575 - Method of Measuring Machinery Sound within Equipment Space.
 2. ARI 650 - Air Outlets and Inlets.
- D. American Society of Heating Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 68 - Laboratory Method of Testing In-Duct Sound Power Measurement Procedure for Fans.
2. ASHRAE 70 - Method of Testing for Rating the Air Flow Performance of Outlets and Inlets.
3. ASHRAE Handbook - Systems Volume, Chapter "Sound and Vibration Control".

E. American Society for Testing and Materials

1. ASTM C423 - Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
3. ASTM E413 - Classification for Rating Sound Insulation.
4. ASTM E477 - Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Materials and Prefabricated Silencers.
5. ASTM E596 - Standard Test Method for Laboratory Measurement of the Noise Reduction of Sound-Isolating Enclosures.

F. Sheet Metal and Air Conditioning Contractors':

1. SMACNA - HVAC Duct Construction Standard - Metal and Flexible.
2. SMACNA - Seismic Restraint Manual: Guidelines for Mechanical Systems.

G. National Environmental Balancing Bureau

1. Procedural Standards for Measuring Sound and Vibration.

1.3 PERFORMANCE REQUIREMENTS

A. Vibration & Seismic Control

1. Provide isolation and anchorage equipment, including anchors. See Section 230529 for anchorage criteria.
2. Provide vibration isolation on motor driven equipment, plus connected piping and ductwork as specified in this section and as scheduled within the Drawings.
3. Vibration isolators shall operate in the linear portion of their load versus deflection curve. The curve shall be linear over a deflection range of not less than 50% above the design deflection. The ratio of lateral to vertical stiffness shall be neither less than 0.8 nor greater than 1.5.
4. Vibration isolators shall be non-resonant with equipment forcing frequencies or support structure natural frequencies.
5. Provide minimum static deflection of isolators for equipment, as indicated on the mechanical schedules.
6. Use concrete inertia bases for fans and on base mounted pumps, as indicated on the mechanical schedules.
7. Provide structural work and seismic restraints for pipes and ducts per the SMACNA Guidelines for Seismic Restraint of Mechanical Systems.
8. Determine system weight, load reactions, center of gravity, building capacity to accept loads, and support mechanisms. Then design seismic restraints to meet the criteria established in the California Code of Regulations.

9. Provide calculations by a Professional Structural Engineer, licensed in the State of California substantiating that all supports and anchors meet the seismic load requirements and can accept the generated forces without failure.
10. Provide building structure engineer with required loads and forces required to support and restrain installation.

B. Noise Mitigation

1. Maintain sound level of spaces by utilizing acoustical devices.
2. Maintain sound levels at maximum sound levels as listed in the Mechanical Drawings.

1.4 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures and Section 230000 – Common Work Results for HVAC. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. Vibration & Seismic Control

1. Submit vibration isolation for all equipment in one package, not as part of equipment submittals. All isolators to be of one manufacturer.
2. Calculations and Design Data
 - a. Submit seismic restraint calculations signed and stamped by a structural engineer licensed in the State of California and experienced in the design of isolation and seismic restraint. Note compliance with seismic regulations on submittals.
 - b. Calculate static and dynamic loading due to equipment weight and operation, seismic forces required to select vibration isolators, seismic restraints, and for designing vibration isolation bases. Coordinate design calculations with wind load calculations required for equipment mounted outdoors.
 - 1) Calculations shall clearly show equipment weight, equipment center of gravity, location of attachment to the structure, and the seismic and gravity forces at each attachment location. Include designs for the attachment of the equipment or equipment support base to the structure, and the equipment to the support base.
 - 2) To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
 - 3) Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - 4) Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors.
 - 5) Where a force resisting support is required, this support design and the calculations showing that the structure can accommodate the load shall be provided by a licensed Professional Structural Engineer.

- c. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
- d. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

3. Product Data

- a. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - 1) Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - 2) Annotate to indicate application of each product submitted and compliance with requirements.
- b. Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials, dimensional data and static deflection. Denote exact model number that is to be used cross referenced against equipment tag. Submit manufacturers load versus deflection curves.
- c. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

4. Shop Drawings

- a. Indicate inertia bases including size and weight. Indicate location of vibration isolators and seismic snubbers on bases.
- b. Indicate location and type of vibration isolators, with static and dynamic load on each.
- c. Indicate location and type of seismic restraints for equipment, ductwork and pipework.
- d. Coordination Drawings: Show coordination of seismic bracing for HVAC piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

5. Welding certificates.

6. Manufacturer's Field Reports: Indicate sound isolation installation is complete and in accordance with instructions.

C. Noise Mitigation

- 1. Indicate assembly, dimensional data, layout, and connection details for sound attenuation products fabricated for this project.
- 2. Shop Drawings: Indicate assembly, materials, thicknesses, dimensional data, pressure losses, acoustical performance, layout, and connection details.

3. Product Data: Provide catalog information indicating, materials, dimensional data, and pressure losses. Indicate dynamic insertion loss and noise generation values of acoustical devices and conformance with Reference Standards applicable. Submit VOC data for lagging adhesives and duct liner adhesives.
4. Factory Test Reports for Acoustical and Aerodynamic Performance: Indicate dynamic insertion loss and regenerated noise values of silencers to meet the values shown on the mechanical equipment schedules. Do not exceed static pressure drops indicated in the equipment schedules.
5. Manufacturers Installation Instructions: Indicate Installation requirements which maintain integrity of sound isolation.
6. Manufacturers Field Reports: Indicate installation is complete and in accordance with instructions.
7. Schedule of acoustic lining, showing type, thickness and location.

1.5 CLOSEOUT SUBMITTALS

- A. Division 1- Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of equipment and noise reducing treatments defined in this section. Record actual locations of hangers including attachment points, loads and static deflection at time of building handover.

1.6 QUALITY ASSURANCE

- A. Vibration and Seismic Control
 1. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
 2. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
 3. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval by an agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- B. Noise Mitigation
 1. Perform Work in accordance with AMCA 300, ANSI S1.13, ARI 575, ANSI S12.36, and standards and recommendations of ASHRAE 68.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.

- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.
 - C. Design application of seismic snubbers anchorage and restraint under direct supervision of Professional Engineer experienced in design of this Work and licensed in State of California.
- 1.8 FIELD MEASUREMENTS
- A. Verify field measurements prior to fabrication.
- 1.9 WARRANTY
- A. Division 1- Execution and Closeout Requirements: Product warranties and product bonds.

PART 2 - PRODUCTS

2.1 GENERAL

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 BASES

- A. Manufacturers:
 - 1. Mason Industries.
 - 2. M. W. Saussé & Co.
- B. Brackets to equipment (abbreviation on schedules – B).
 - 1. Height saving brackets attached directly to equipment where rigidity of same does not require supplemental frame.
 - 2. Brackets to prevent drop of frame more than 3/8-inch.
 - 3. Basis of design: Mason.
- C. Structural Steel Bases (abbreviation on schedules - SB):
 - 1. Factory-fabricated, welded, structural-steel bases and rails. Gusset brackets, supporting equipment and motor with motor slide rails.
 - 2. Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
 - 3. Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Sufficiently rigid to prevent misalignment or undue stress on machine, and to transmit design loads to isolators and snubbers.

4. Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support. Include supports for suction and discharge elbows for pumps.
5. Base depth shall be at least one-tenth the longest dimension of the base, but not more than 12 inches. Brackets to prevent drop of frame more than 3/8-inch.
6. Basis of design: Mason type WFSL.

D. Concrete Inertia Bases (abbreviation on schedules - CIB):

1. Structured steel channel perimeter frame, with gusset brackets and anchor bolts, adequately reinforced, concrete filled.
2. Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
3. Connecting Point: Reinforced to connect isolators and snubbers to base.
4. Minimum of 1.5 times weight of isolated equipment.
5. Concrete: Reinforced 3,000 psi (20 MPa) concrete.
6. Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.
7. Forms shall include minimum concrete reinforcement consisting of half-inch bars or angles welded in place on 6 inch centers running both ways in a layer 1-1/2 inches above the bottom, or additional steel members to hold anchor-bolt sleeves when the anchor bolts fall in concrete locations.
8. Lowest possible mounting height with not less than 1-inch (25-mm) clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails.
9. Factory-welded steel brackets on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support. Include supports for suction and discharge elbows for pumps
10. Bases for pumps shall be large enough to provide support for suction and discharge elbows.
11. The base depth shall be a minimum of 1/12th of the longest dimension of the base, but not less than 6 inches. The base depth need not exceed 12 inches unless specifically recommended by the base manufacturer for mass or rigidity.
12. Basis of design: Mason type K.

2.3 PIPE AND DUCT SUPPORTS

A. Manufacturers

1. Superstrut
2. B-Line
3. Hubbard Holdrite Silencer

2.4 VIBRATION ISOLATORS

A. Manufacturers:

1. Mason Industries
2. MW Sausse & Co.
3. Vibroacoustics

4. Or approved equivalent

B. General Requirements

1. Isolators shall be selected by the supplier, even if sizing is shown. Size vibration isolators on single piece of equipment for equal static deflections based on actual static and dynamic weight distribution per point of support furnished by equipment manufacturer. Dynamic loads include those due to: wind, fluid flow, thrust and rotations inertial. Select each isolator independently for the load distribution on the equipment base, duct or pipe support.
2. In determining weight of equipment, include concrete inertia bases, grout filled pump bases, etc.
3. Use as few isolators on each piece of equipment as practical. For example, 4 isolators on small equipment and inertia bases.
4. Vibration isolators shall have either known height without a load or other markings so that after adjustment, when fully loaded, the deflection can be verified.
5. Provide all floor-mounted spring isolators with mounting base plates that provide for bolting to the floor and incorporate neoprene bearing pads.
6. Supply all miscellaneous steel to make support compatible with equipment.
7. Mount motors on rigid base common with equipment or supported from equipment frame.
8. Provide static deflection as noted in the schedules within the Mechanical Drawings.

C. Open Free-Standing Spring Isolators (abbreviation in schedules - FS):

1. Spring Isolators
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 - b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 100 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Free standing and laterally stable spring isolators (single or multiple steel springs) without any housing and complete with 1/4 inch neoprene acoustical pads between the base plate and the support.
4. Spring diameter shall be no less than 0.8 of the compressed height of the spring at design load.
5. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.
6. Sound Pads: Size for minimum deflection of 0.05 inch (1.2 mm); meet requirements for neoprene pad isolators.
7. Provide all mountings with leveling bolts, rigidly bolted to the equipment.
8. Provide height saving mounting brackets where applicable, height adjustment bolts.
9. Basis of design: Mason type SLF.

D. Restrained Spring Isolators (abbreviation on schedules – RS)

1. Spring Isolators:

- a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs
 - b. Code: Color code springs for load carrying capacity.
 2. Springs: As in type FS.
 3. Spring Mounts: As in type FS.
 4. Sound Pads: As in type FS.
 5. Restraint: Furnish mounting frame and limit stops. A minimum 1/2 inch clearance shall be maintained around the restraint bolts, housings, and springs so as not to interfere with the spring action.
 6. Basis of design: Mason type SLR.
- E. Spring Hanger (abbreviation on schedules - SH)
 1. Spring Isolators:
 - a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
 2. Springs: Freestanding, laterally stable steel spring with a neoprene element in series. Color code springs for load carrying capacity.
 3. Housings: Incorporate rubber hanger with threaded insert.
 4. Misalignment: Capable of 20 degree hanger rod misalignment.
 5. Basis of design: Mason type 30N.
- F. Roof Spring Curb (abbreviation on schedules - RSC):
 1. Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment and to withstand seismic forces.
 2. Lower Support Assembly: Formed sheet-metal section containing adjustable and removable steel springs that support upper frame. Upper frame shall provide continuous support for equipment and shall be captive to resiliently resist seismic forces. Lower support assembly shall have a means for attaching to building structure and a wood nailer for attaching roof materials, and shall be insulated with a minimum of 2 inches of rigid, glass-fiber insulation on inside of assembly.
 3. Restrained Spring Isolators: Freestanding, steel, open-spring isolators with seismic restraint.
 - a. Adjustable, restrained spring isolators shall be mounted on 1/4 inch thick, elastomeric vibration isolation pads and shall have access ports, for level adjustment, with removable waterproof covers at all isolator locations. Isolators shall be located so they are accessible for adjustment at any time during the life of the installation without interfering with the integrity of the roof.
 - b. Springs vertically and laterally restrained using neoprene isolated bolts.
 - c. Provide leveling bolts and cadmium-plated or galvanized hardware.
 - d. Housing: Steel with resilient vertical-limit stops and adjustable equipment mounting and leveling bolt.
 - e. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
 - f. Minimum Additional Travel: 50 percent of the required deflection at rated load.
 - g. Lateral Stiffness: More than 80 percent of rated vertical stiffness.

- h. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
 - i. Pads: Arranged in single or multiple layers of sufficient stiffness for uniform loading over pad area, molded with a nonslip pattern and galvanized-steel baseplates, and factory cut to sizes that match requirements of supported equipment. Oil- and water-resistant standard neoprene.
 - j. Snubber Bushings: All-directional, elastomeric snubber bushings at least 1/4 inch thick.
 - k. Water Seal: Galvanized sheet metal with EPDM seals at corners, attached to upper support frame, extending down past wood nailer of lower support assembly, and counterflashed over roof materials.
 - l. Basis of design: Mason RSC.
- G. Neoprene Pad Isolators (abbreviation on schedules – NP)
 - 1. Rubber or neoprene-waffle pads.
 - a. Durometer to achieve static deflection as specified.
 - b. Minimum 1/2 inch (13 mm) thick.
 - c. Maximum loading 40 psi (275 kPa).
 - d. Height of ribs: not to exceed 0.7 times width.
 - 2. Configuration: 1/2 inch (13 mm) thick waffle pads bonded each side of 1/4 inch (6 mm) thick steel plate.
 - 3. Basis of design: Mason type WM.
- H. Neoprene Mount (abbreviation on schedules – NM)
 - 1. Molded rubber designed for 0.2 inches (5 mm) deflection with all direction seismic restraint.
 - 2. Basis of design: Mason type BR or equal.
- I. Neoprene Hangers (abbreviation on schedules – NH)
 - 1. Double deflection neoprene in shear, sized for deflection under loads of 0.3 to 0.5 inch.
 - 2. A neoprene neck bushing shall be provided where the hanger rod passes through the hanger housing to prevent the rod from contacting the hanger housing.
 - 3. Misalignment: Capable of 30 degree arc before contacting hanger housing
 - 4. Basis of design: Mason type HD
- J. Risers
 - 1. Type RC: Vertical riser piping support/suspension. Pipe clamps as specified in Section 230529 – Hangers and Supports for HVAC Piping and Equipment, supported on each side by pairs of vertical acoustical pipe anchor mountings with two layers of 1/4-inch thick ribbed or waffled neoprene pad loaded to not more than 50 psi. Isolation pads separated by 1/4-inch steel plate. Weld pipe riser clamps at anchor points to the pipe and to anchor mounting pairs. Rigidly fasten mounting pairs to structure. Alternate means of isolation will be considered but shall be engineered by

Contractor and submitted to Architect, complete with detailed calculations, installation and adjustment instructions from supplier.

2. Type RG: Provide all-directional, resiliently supported vertical riser piping support/suspension from structure. Single point of support desired. Multiple points of support acceptable, but must be engineered, complete with detailed installation and adjustment instructions by supplier. Resilient anchors to preclude direct contact of piping with structure yet provide a neutral point for expansion/contraction of piping. Neoprene element to be no less than 0.50" thick. Mason ADA or VSG.

K. Resilient attachments:

1. Type RA-1: 3/4-inch nominal thickness resilient pipe sleeve between pipe and clamp or hanger.
 - a. Operating temperature at or below 80 degrees F, except in plenums: Armstrong Armaflex, Manville Aerotube or approved equal.
 - b. Operating temperature above 80 degrees F or in plenums: preformed glass fiber pipe insulation not exceeding 6 pcf.
2. Type RA-2: Manufactured insulated hanger for uninsulated pipe: Superstrut P/A-716 Cush-A-Clamp, Unistrut, B-line or approved equal.
3. Type RA-3: Manufacturer resilient attachment for water pipes 1 inch and less diameter: Technical Specialties Acousto-Plumb System (orange and blue).

L. Other Supports:

1. Type T: Trapeze. Supporting sling of steel member with mount or hangers at each end. Used to distribute load or to conserve space.
2. Type S: Stanchion support. A supporting arm or system for equipment or piping between the isolator and load.
 - a. Type "cable" seismic restraints of galvanized aircraft cable. Assembly complete with two "U" bolt clamps per end. Allowed loads shall contain a safety factor of three when worst-case loading applied to one cable. Cable shall be installed with 1/4-inch slack to prevent the transmission of vibration to the structure.

2.5 SEISMIC RESTRAINTS

A. Manufacturers:

1. Mason Industries.
2. Hilti, Inc.
3. TOLCO Incorporated; a brand of NIBCO INC.
4. Seismic Snubbers
 - a. All directional seismic restraints shall consist of interlocking steel members restrained by a one-piece molded bushing or bridge-bearing neoprene.
 - b. Capacity: 4 times load assigned to mount groupings at 0.4 inch (10 mm) deflection.
 - c. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

- d. Snubbers must not limit vibration isolation capability during normal operation.
- e. Neoprene Elements: Replaceable, minimum of 0.75 inch (18 mm) thick.
- f. Provide neoprene material with anti-ozone and anti-oxidant additives.
- g. Provide EPDM or equal elastomeric elements in place of neoprene on all vibration isolators installed outdoors.
- h. Incorporate a minimum air gap of 1/8 inch in the snubber design in all directions before contact is made between the rigid and resilient surfaces.
- i. Snubber bushings shall be free to rotate.
- j. Provide removable snubber ends to allow inspection of internal clearances.
- k. Neoprene bushing shall be easily rotated to ensure no short circuits exist.
- l. Basis of design: Mason type Z1011.

B. Seismic Slack Cables

1. Galvanized steel aircraft cables sized to resist seismic loads with a minimum safety factor of two and arranged to provide all-directional restraint.
2. Cables must be prestretched to achieve a certified minimum modulus of elasticity.
3. Cable end connections shall be steel assemblies that swivel to final installation angle and utilize two clamping bolts to provide proper cable engagement.
4. Basis of design: Mason type SCB

C. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.

D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings, and matched to type and size of anchor bolts and studs.

E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings, and matched to type and size of attachment devices used.

F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

G. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

H. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing polyvinyl or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

I. Thrust Restraints

1. Thrust restraint shall consist of a spring element in series with a neoprene pad. The unit shall be designed to have the same deflection as specified for the isolators supporting the equipment. The spring element shall be contained within a steel frame and be designed so it can be preset at the factory for thrust and be adjusted in the

- field to allow for a maximum of 1/4 inch movement during starting or stopping of the equipment.
2. The assembly shall be furnished complete with rods and angle brackets for attachment to both the equipment and the adjacent fixed structural anchor.
 3. Thrust restraints shall be provided for all equipment as follows:

Spring Isolator Deflection	Thrust
3 inches or more	greater than 5% of equipment weight
2 inches	greater than 10% of equipment weight
1 inch	greater than 15% of equipment weight

4. Note: Equipment weight includes all isolated items including vibration isolation base.
5. Basis of design: Mason type WB.

2.6 DUCT SILENCERS

A. Manufacturers:

1. VibroAcoustics.
2. Price Industries
3. Or approved equivalent.

B. Performance: Achieve insertion loss, self-generated noise, and static pressure drop for cfm flow required per schedules on Drawings.

C. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2013.
4. Material of duct silencer shall match adjacent ductwork material.

D. Manufacturers to meet performance scheduled on drawings and specified herein. Attenuations indicated on Drawings are minimum dynamic insertion losses, together with self-noise power levels, and shall have been determined by an independent testing laboratory.

E. Source Quality Control: Test according to ASTM E 477.

1. Record acoustic ratings, including dynamic insertion loss and generated-noise power levels with a forward flow and reverse flow for air velocities representative of the installation.

2. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 8-inch wg (2000-Pa) static pressure, whichever is greater. Silencer must not deform or experience structural failure under this differential pressure.
3. Static pressure loss of the attenuators at the operating airflow, shall not exceed the values listed in the silencer schedules. Airflow measurements shall be made in accordance with ASTM E477 and applicable airflow codes.

F. Rating:

1. ASTM E477 Minimum Required Insertion Loss and Maximum Allowable Generated Noise at 1000 fpm (7 m/sec). See schedules on Drawings.
2. Static Pressure Drop: See schedules on Drawings.
3. Air Tight Static Pressure: 10 inches wg (2.5 kPa).
4. Configuration: Rectangular with lined splitters with radius nose and contoured tails, modular. Install attenuators in banks as required. Seal airtight with non-hardening caulk between each attenuator. Reinforce banks with galvanized steel angle framework as necessary to assure rigid installation and adequate support. Round straight with lined splitters with radius nose and contoured tails.

G. Materials:

1. Rectangular Outer Casing: Minimum 22 gage (0.8 mm) thick galvanized steel stiffened with mastic filled lock formed, welded seams, 2 inch (50 mm) long, 11 gage (2.9 mm) slip joints on both ends.
2. Round Silencer Outer Casing:
 - a. Sheet Metal Thickness for Units up to 22 Inches (560 mm) in Diameter: 22 gauge galvanized
 - b. Sheet Metal Thickness for Units greater than 22 inches (560 mm) in Diameter: 18 gauge galvanized
3. Inner Casing and Splitters: Minimum 24 gage (0.6 mm) thick perforated galvanized steel.
4. Fill Material: Inert and vermin-proof moisture-proof mineral glass fiber material that will import no odor to the airstream, packed under not less than 5 percent compression to eliminate voids with a density in excess of 4 lb/cu ft (64 kg/cu m)
5. Erosion Barrier: Polymer bag enclosing fill, and heat sealed before assembly.
6. Fill Liner: Bonded glass fiber matting with addition of 1 mil (0.0254 mm) Mylar film when explicitly specified as “encapsulated.”

H. Fabricate silencers to form rigid units that will not pulsate, vibrate, rattle, or otherwise react to system pressure variations. Do not use mechanical fasteners for unit assemblies.

1. Lock form and seal.
2. Suspended Units: Factory-installed suspension hooks or lugs attached to frame in quantities and spaced to prevent deflection or distortion.
3. Reinforcement: Cross or trapeze angles for rigid suspension.
4. Perforated metal shall be adequately stiffened to ensure flatness and form with painted spot welds.

- I. Indelibly mark attenuators with manufacturer's name, product designation, project and unit reference numbers, and airflow direction.
 - J. Connection Sizes: Transition connecting ductwork to scheduled attenuator size with maximum 30deg. walls unless otherwise indicated.
- 2.7 POLYESTER DUCT LINER:
- A. Manufacturers:
 - 1. Ductmate Polyarmor (only allowable).
 - 2. Or owner approved equivalent.
 - B. Refer to Mechanical Drawings for locations and thicknesses of duct lining. Duct lining is only allowed where explicitly shown in the Mechanical Drawings.
 - C. Comply with NFPA 90A or NFPA 90B and with NAIMA AH124
 - D. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.
 - E. Thermal Conductivity (k-Value): 0.26 at 75 deg F mean temperature.
 - F. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
 - G. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
 - 1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 - H. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.
 - 1. Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
 - 2. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
 - 3. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.
 - I. All acoustical duct lining shall incorporate means to prevent fiber entrainment in the air stream. Metal covers shall be provided at the liner's cut edges perpendicular to flow to prevent fiber delamination. All lining shall be positively retained in place.
 - J. Minimum sound-absorption coefficients (ASTM C423 Mounting Type A) for sound-absorbing duct lining material:

	Octave Band Center Frequency, Hz					
Lining Type	125	250	500	1000	2000	4000
1-inch (25-mm) thickness lining,	0.2	0.4	0.9	0.9	0.5	0.2
1.5-inch (37-mm) thickness lining,	0.3	0.5	0.9	0.9	0.4	0.2

2.8 ENCAPSULATED FIBROUS-GLASS LINER:

A. Manufacturers:

1. CertainTeed Corp.
2. Johns Manville.
3. Knauf Fiber Glass.
4. Owens Corning.

B. All fibrous lining shall be covered with Tedlar (or equivalent) and perforated metal plate as required by GPR to prevent fibers from entering the airstream.

C. Comply with NFPA 90A or NFPA 90B and with NAIMA AH124

D. Materials: ASTM C 1071; surfaces exposed to airstream shall be coated to prevent erosion of glass fibers.

E. Thermal Conductivity (k-Value): 0.26 at 75°F mean temperature.

F. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.

G. Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

1. For indoor applications, use adhesive that has a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

H. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in duct.

1. Tensile Strength: Indefinitely sustain a 50-lb tensile, dead-load test perpendicular to duct wall.
2. Fastener Pin Length: As required for thickness of insulation and without projecting more than 1/8 inch into airstream.
3. Adhesive for Attaching Mechanical Fasteners: Comply with fire-hazard classification of duct liner system.

I. All acoustical duct lining shall incorporate means to prevent fiber entrainment in the air stream. Metal covers shall be provided at the liner's cut edges perpendicular to flow to prevent fiber delamination. All lining shall be positively retained in place.

- J. Minimum sound-absorption coefficients (ASTM C423 Mounting Type A) for sound-absorbing duct lining material:

	Octave Band Center Frequency, Hz					
Lining Type	125	250	500	1000	2000	4000
1-inch (25-mm) thickness lining, 2 –3 pcf (32 – 48 kg/cu m) density	.05	.25	.50	.70	.85	.85
2-inch (50-mm) thickness lining, 2 –3 pcf (32 – 48 kg/cu m) density	.25	.50	.90	.90	.90	.90

2.9 INSULATION PINS AND WASHERS:

- A. Cupped-Head, Capacitor-Discharge-Weld Pins: zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135" diameter shank, length to suit depth of insulation indicated with integral 1-1/2" galvanized carbon-steel washer.
- B. Insulation-Retaining Washers: Self-locking washers formed from 0.016" thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2" in diameter.

2.10 SHOP APPLICATION OF DUCT LINER:

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
- B. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
- C. Apply adhesive / edge seal to transverse edges of liner facing upstream and downstream that do not receive metal nosing.
- D. Butt transverse joints without gaps, and coat joint with adhesive.
- E. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
- F. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
- G. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
- H. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:

1. Fan discharges.
 2. Intervals of lined duct preceding unlined duct.
 3. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
- I. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
1. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
- J. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.11 ACOUSTICALLY RATED FLEXIBLE DUCTS

A. Manufacturers:

1. Flexmaster U.S.A., Inc.
2. Thermaflex MKE.
3. Or approved equivalent

- B. Acoustically rated flexible duct: Where shown on the drawings, acoustically rated ductwork shall meet the following insertion loss values (dB) for a 6' long section which includes a 90 degree elbow.

Octave band center frequency (Hz)		63	125	250	500	1000	2000	4000
Insertion Loss dB	6" dia	13	20	23	25	25	25	25
	8" dia	14	21	23	22	22	23	25
	12" dia	14	18	20	20	20	19	19

C. Regenerative Noise:

1. Noise due to air turbulence within the duct shall not exceed the following sound power levels for a 12" diameter duct with an air speed of 1000fpm.

Octave band center frequency (Hz)	125	250	500	1000	2000
Sound power levels (dB) referenced to 10-12 watts	30	31	30	22	20

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches (75 through 460 mm), to suit duct size.
- E. Thermal Performance:
1. Pressure Rating: 4-inch wg (1000 Pa) positive and 0.5-inch wg (125 Pa) negative.
 2. Maximum Air Velocity: 4000 fpm (20.3 m/s).
 3. Temperature Range: Minus 20 to plus 175 deg F (Minus 28 to plus 79 deg C).
 4. Water Vapor Permeance: 0.17 grains per sq. ft. per hour per inch of Hg. (Test Method: ASTM E 96, Procedure A)
 5. Insulation R-Value: R-4.2 minimum at 75°F.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 013100 - Project Management and Coordination: Coordination and project conditions.
- B. Examine areas and equipment to receive vibration isolation and seismic control devices for compliance with requirements for installation tolerances and other conditions affecting performance.
- C. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General:
 1. Suspend the vibration isolators supporting piping, ductwork and equipment from structural members.
 2. Provide 2 inches minimum clearance between the top of the housekeeping pad or floor and the underside of concrete inertial pads and/or steel equipment support frames.
 3. Fasten all vibration isolators to the structure, not to floor diaphragms or lightweight components. Use bolts where holes are provided in the mounting flanges; otherwise, adhere using structural adhesive. Where mounting flanges are steel, use neoprene grommets and washers under anchor bolts.
 4. Do not use vibration isolation components to straighten or connect misaligned sections of piping or ductwork.
 5. Align spring isolation hanger rods to clear the hanger box under all operating conditions.
 6. Any bracing or supports for mechanical ductwork, piping, and equipment shall not bridge or reduce the effectiveness of vibration isolators.
 7. Level vibration isolated equipment under rated design operating conditions while maintaining the isolation criteria. Isolators shall be plumb and aligned to preclude misalignment or undesired contact during operation.

8. Piping and ductwork to be isolated shall pass freely through walls and floors without rigid connections. Maintain $\frac{3}{4}$ -inch to $1\frac{1}{4}$ -inch concentric clearance around outside surfaces of piping or ductwork at penetration points. Pack this clearance space tightly with fiberglass, and caulk airtight after installation of piping or ductwork, or provide resilient firestopping as required. Provide supports 6 to 8 inches from walls or partitions on both sides of penetrations.
9. Do not make rigid connections between equipment and building structure that degrade or short circuit the vibration isolation system specified herein.
10. Provide flexible connectors at all isolated equipment as allowed by codes and/or local authorities. Braided steel flexible connectors are not acceptable.
11. Loop electrical circuit connections to isolated equipment to allow free motion. Include at least one slack 90° bend.
12. Install isolators with the isolator hanger box attached to, or hung as close as possible to, the structure. Provide outrigger supports where required for clearance to equipment and to maintain minimum clearance of equipment to structure above.
13. Replace bent rods.

B. Equipment:

1. See mechanical equipment schedules on Drawings for equipment isolation requirements.

3.3 INSTALLATION – VIBRATION & SEISMIC CONTROL

- A. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- B. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.
- C. Level vibration isolated equipment under rated design operating conditions while maintaining the isolation criteria. Isolators shall be plumb and aligned to preclude misalignment or undesired contact during operation.
- D. Bases: Set steel bases for 1 inch (25 mm) clearance between housekeeping pad and base.
- E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.
- F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- G. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide snubbers with clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).
- H. Provide pairs of thrust restraint horizontal limit springs on fans based on static pressure.
- I. Fasten all vibration isolators to the structure, not to floor diaphragms or lightweight components. Use bolts where holes are provided in the mounting flanges; otherwise,

adhere using structural adhesive. Where mounting flanges are steel, use neoprene grommets and washers under anchor bolts. Anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

- J. Do not use vibration isolation components to straighten or connect misaligned sections of piping or ductwork.
- K. Do not make rigid connections between equipment and building structure that degrades or short circuits the vibration isolation system specified herein. Any bracing or supports for mechanical ductwork, piping, and equipment shall not bridge or reduce the effectiveness of vibration isolators.
- L. Support piping connections to isolated chillers and pumps resiliently for distance scheduled below.
 - 1. Select three hangers closest to vibration source for minimum 1.0 inch (25 mm) static deflection or static deflection of isolated equipment, whichever is larger. Select remaining isolators for minimum 1.0 inch (25 mm) static deflection or 1/2 static deflection of isolated equipment, whichever is larger.

Pipe Size Inch (mm)	Isolated Distance from Vibration Isolated Equipment Diameters
1 (25)	120 diameters
2 (50)	90 diameters
3 (80)	80 diameters
4 (100)	75 diameters
6 (150)	60 diameters

- M. Provide seismic bracing per latest applicable building codes for all piping.
- N. Install isolators with the isolator hanger box attached to, or hung as close as possible to, the structure. Provide outrigger supports where required for clearance to equipment and to maintain minimum clearance of equipment to structure above.
- O. Align spring isolation hanger rods to clear the hanger box under all operating conditions.
- P. Install cables so they do not bend across edges of adjacent equipment or building structure.
- Q. Provide flexible connectors to all other connections to vibration isolated equipment such as condensate drains, and other piping as allowed by codes and/or local authorities.
- R. Install flexible connections at all connections to vibration isolated equipment, rotating, reciprocating and other vibrating equipment.

3.4 INSTALLATION – NOISE MITIGATION

- A. Duct Silencers:

1. Install duct silencers in accordance with manufacturer's instructions.
2. All attenuators shall be installed in locations as shown on the drawings with adequate lengths of straight duct to prevent increased pressure drop.
3. Support duct silencers independent of ductwork.
4. Do not locate duct silencers within one duct diameter from fan discharge/intake openings, elbows, or takeoffs.
5. All attenuators downstream of elbows shall be oriented with the internal baffles parallel to the plane of the elbow. When elbows precede duct silencer by less than 3 duct widths (as measured in the elbow plane), splitters should be parallel to the plane of the elbow turn.

B. Liner:

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to liner that faces direction of airflow not receiving metal nosing.
3. Butt transverse joints without gaps and coat joint with adhesive.
4. Fold and compress liner in corners of casings or cut and fit to ensure butted-edge overlapping.
5. Do not apply liner with longitudinal joints, except at corners of casings, unless casing size and standard liner product dimensions make longitudinal joints necessary.
6. Secure liner with mechanical fasteners 4 inches (100 mm) from corners and at intervals not exceeding 12 inches (300 mm) transversely; at 3 inches (75 mm) from transverse joints and at intervals not exceeding 18 inches (450 mm) longitudinally.
7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profile or are integrally formed from casing wall.

C. Flexible Ductwork

1. To achieve the required sound absorption at the diffuser, all diffusers shall have 5' to 7' length of acoustically rated flexible ductwork at the outlet and a required for at least one and no more than two 90° bends. See 233713 for diffuser specification.

3.5 ADJUSTING

- A. Adjust isolators after piping system is at operating weight.
- B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
- C. Adjust active height of spring isolators.
- D. Adjust restraints to permit free movement of equipment within normal mode of operation.

3.6 FIELD QUALITY CONTROL

- A. Division 1- Quality Requirements - Execution and Closeout Requirements: Field inspecting, testing, adjusting, and balancing.

- B. Vibration isolation manufacturer representative to supervise and inspect all installed isolation hardware and generate punchlist for Construction Administrator along with corrective measures required. Submit inspection report.
- C. Present vibration measurement data in comparison with the limitations of ASHRAE 2015 Applications table 46 on page 48.44 for allowable RMS velocity in in/s. Pumps 0.13, Fans 0.09, Compressors 0.13.
- D. The contractor shall cooperate with regard to sound tests (ARI 575, ANSI S1.13) which may be conducted by the testing, adjusting, and balancing contractor and/or the Owner to verify that noise criteria are met.
- E. The contractor shall notify the Construction Administrator of any changes which will affect the acoustical performance.

END OF SECTION

SECTION 230553 - IDENTIFICATION FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section. Where conflicts occur between divisions, the more stringent requirement shall apply.

B. SUMMARY

1. Section Includes:

- a. Equipment labels.
- b. Warning signs and labels.
- c. Pipe labels.
- d. Duct labels.
- e. Stencils.
- f. Valve tags.
- g. Warning tags.

C. Related Sections:

1. Section 230000 – Basic Mechanical Requirements
2. Section 230713 – HVAC Insulation.
3. Section 232113 – Hydronic Piping.
4. Section 233113 – HVAC Ducts.
5. Section 23 – All Equipment sections.

- D. Mechanical identification and painting scheme to be established during project development.

1.2 REFERENCE

A. American Society of Mechanical Engineers:

1. ASME A13.1 – Scheme for the Identification of Piping Systems.

1.3 COORDINATION

- 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 visibility from locations of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

1.4 SUBMITTALS

- A. Contractor to submit equipment identification tags, piping identification markers, and ductwork identification markers.
- B. Product Data: Submit product data under provisions of Section 013300 – Submittal Procedures and Section 230000 – Basic Mechanical Requirements. Where conflicts occur between divisions, the more stringent requirement shall apply.
- C. Samples: Submit samples for color, letter style, wording and graphic representation required for each identification material and device.
- D. Equipment Label and Notice Sign Schedule: Include a listing of all equipment labels with the proposed content for each label and proposed color scheme. Include in the operations and maintenance manual submittal and as an excel spreadsheet.
- E. Submit valve numbering scheme, location, function, manufacturer's name, model number, and valve tag content as an excel spreadsheet.
- F. Manufacturer's Installation Instructions: Indicate installation instructions, special procedures, and installation.

1.5 QUALITY ASSURANCE

- A. Pipe marker shall comply with ASME A13-1 for color scheme for identification of piping systems and accessories.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years' experience.

1.7 EXTRA MATERIALS

- A. Division 1- Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish 20 extra pipe markers and 20 extra ductwork stickers for every pipe size and system type (i.e. CHW, HHW, SA, RA, EA)

PART 2 - PRODUCTS

2.1 MANUFACTURER

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified. The first manufacturer listed represents the basis of design as scheduled and drawn in the Construction Documents.

2.2 EQUIPMENT LABELS

- A. All mechanical equipment shall be provided with nameplate securely attached to the equipment. Nameplates shall bear the notations corresponding to the notations on the operating instructions and drawings. Secure a nameplate to each starter, switch, relay, transformer, control device, etc. that controls the equipment, and to all scheduled equipment in the building. Visible in-room wall mounted controllers may have tags on the inside of the removable cover using on plastic coated sticks.
- B. Manufacturers:
 - 1. W.H.Bradley.
 - 2. Seton Identification Products.
 - 3. Kolbi.
- C. Metal Labels for Equipment:
 - 1. Material and Thickness: Stainless steel, brass or anodized aluminum, 0.032-inch (0.8-mm) minimum thickness. For outdoor or potentially wet environment use, use stainless steel.
 - 2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 3. Minimum tag height of 1 inch with minimum lettering height of 3/4 inch.
 - 4. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label, with substrate, and with anticipated temperature of equipment. For outdoor or potentially wet environment use, use only stainless steel rivets.
 - 5. Nameplates shall bear notations corresponding to notations on operating instructions and Drawings.
- D. Plastic Labels for Equipment:
 - 1. Material and Thickness: Three layer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware. These may not be used in outdoor applications unless proven to be color fast in Southern California environment.
 - 2. Letter Color: White
 - 3. Background Color: Black
 - 4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
 - 5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
 - 6. Minimum tag height of 1 inch with minimum lettering height of 3/4 inch.
 - 7. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and with substrate. If outdoor or wet environment use only stainless steel rivets.
 - 8. Nameplates shall bear notations corresponding to notations on operating instructions and Drawings.
- E. Secure nameplate to each switch, relay, transformer, etc. that controls the equipment.
- F. Label Content: Include equipment's Drawing designation or unique equipment number.

2.3 PIPE LABELS

A. Manufacturers:

1. Seton Identification Products.
2. W.H.Bradley.
3. Kolbi.

B. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger pipe sizes may have maximum sheet size with separate fastener. This is preferred option for outdoor or wet environment use.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing. Each marker shall show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length. If used outdoors, provide information regarding adhesive longevity and color fastness in Southern California environment.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: 2 inch letter size for pipe or insulation 3 inches or larger. 1 inch letter size for pipe or insulation 2-1/2 inches or smaller.
3. Nameplate markers will be on contrasting colors at 30' on center.

E. Color Coding:

HVAC Piping	Background Color	Lettering Color	Jacketing or Paint within mechanical rooms or yards
Heating Hot Water Return	Yellow	White	Orange PVC Jacket
Heating Hot Water Supply	Yellow	White	Orange PVC Jacket
Condensate Drain and Overflow Drain Piping	Green	White	Blue PVC Jacket
Vent and Safety Relief Vent Piping	Yellow	Black	Yellow Paint
Chemical Treatment Piping	Yellow	Black	Yellow Paint or Yellow PVC Jacket
Industrial Cold Water	Green	White	None
Refrigerant Liquid and Gas Line	Yellow	Black	Black Paint

Note: See Section 230700 for PVC jacketing requirements.
See Sections 099000 for exterior and interior painting.

2.4 DUCT LABELS

- A. Duct markers shall be stenciled onto the duct or provided via stickers with legend and flow arrow. Markers shall be located at either side of a wall penetration and every 30 feet of accessible duct. Where duct is visible to the public, coordinate with architect regarding location of marker.
- B. Manufacturers:
1. Seton Identification Products.
 2. W.H. Bradley.
 3. Kolbi.
- C. Self-Adhesive Duct Labels: Printed plastic with contact-type, permanent-adhesive backing. Each marker must show accepted color-coded background, proper color of legend in relation to background color, accepted legend letter size, accepted marker length. If used outdoors, provide information regarding adhesive longevity and color fastness in Southern California environment.
- D. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions or as separate unit on each duct label to indicate flow direction.
 2. Lettering Size: Letters shall be 2 inches high, black lettering on white background.
- E. Color Coding:

HVAC Ductwork	Background Color	Lettering Color
Exhaust Air Ducts	Yellow	Black
Outside Air Ducts	Green	White
Return Ducts	Green	White
Supply Ducts	Green	White
Grease Ducts	Yellow	Black
Lab Exhaust Duct	Yellow	Black

2.5 VALVE TAGS

- A. Provide stamped metal tags on all valves.
1. Manufacturers:
 2. Seton Identification Products.
 3. W.H. Bradley.
 4. Kolbi
- B. Valve Tags: Attach to handwheel or stem of each control and line shutoff valve installed under this Division. Stamped or engraved with minimum 1 inch high designating numbers.
1. Tag Material: Stainless steel or brass, 0.032-inch (0.8-mm) minimum thickness, and having predrilled or stamped holes for attachment hardware. If outdoor or wet environment outdoors use stainless steel.
 2. Fasteners: Stainless steel or heavy brass, S-hook, or chain. If outdoors or wet environment, use only stainless steel.
- C. Engrave identification tags with "normally open" (green) or "normally closed" (red).
- D. Tag size minimum 1-1/2 inch diameter or square with smooth corners.
- E. Abbreviation Coding for Valve Tags

Service	Lettering -Abbreviation
Heating Hot Water	HHW
Pumped Condensate	PC
Gravity Condensate	GC
Refrigerant	REF

2.6 VALVE AND EQUIPMENT CHARTS

- A. Provide typewritten schedules giving numbers, service and locations, and notations of normal position and future position of all tagged valves. List piping systems with symbol and color coding on pipe identification chart. List valve model numbers and symbol for service corresponding to piping symbol on valve identification chart. Provide small "key plan" identifying valves as related to column lines. Enclose each schedule, list and key plan in separate transparent plastic sheet protector within a binder.
- B. Provide typewritten list of equipment, indicating location, service, area served, with equipment reference number corresponding to as-built drawings.

2.7 CONTROLS

- A. Provide engraved plastic laminate identification of automatic and manual control devices, instruments, and relays, including switches, despite them being furnished under another Division. Thermostats and temperature controllers exposed to view shall have the designation of the piece of equipment served on the label mounted on the face of the device.

2.8 NOTICE SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch (1.6 mm) thick, and having predrilled holes for attachment hardware.
- B. Letter Color: Black.
- C. Background Color: White.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: 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-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel rivets or contact-type permanent adhesive, compatible with label and with substrate.
- H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.9 WARNING TAGS

- A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
 - 1. Size: 3 by 5-1/4 inches (75 by 133 mm) minimum.
 - 2. Fasteners: Brass grommet and wire.
 - 3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
 - 4. Color: Yellow background with black lettering.

2.10 CEILING TACKS

- A. Description: Steel with 3/4 inch (19 mm) diameter color-coded head.
- B. Color code as follows
 - 1. HVAC Equipment: Yellow
 - 2. Fire dampers / Smoke Dampers: Red

3. Heating / Cooling Valves: Blue

2.11 LOCKOUT DEVICES

- A. Lockout Hasps: Hasp with erasable label surface; size minimum 7-1/4 x 3 inches (184 x 76 mm).
 1. Valve Lockout Devices: Steel device preventing access to valve operator, accepting lock shackle.

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 encapsulates. For unfinished canvas covering, apply paint primer before applying labels.
- B. Install identifying devices after completion of insulation, jackets and coverings.

3.2 EQUIPMENT LABEL INSTALLATION

- A. Properly identify each piece of equipment and controls pertaining thereto by nameplates mounted on equipment and controls using round head brass machine screws, pop rivets or contact cement. Cardholders in any form not acceptable.
- B. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- C. Place warning signs on machines driven by electric motors which are controlled by fully automatic starters, in accordance with Article 3281, OSHA General Industry Safety Orders.
- D. Identify rooftop package units and fans with area served.
- E. Identify control panels and major control components outside panels with plastic nameplates
- F. Locate equipment labels where accessible and visible.
- G. Identify equipment out of view behind access doors, in unfinished rooms on the face of the access door.

3.3 PIPE LABEL INSTALLATION

- A. Apply markings after all cleaning, insulating, and painting of piping is completed.
- B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
 1. Within one foot of each valve and control device.
 2. Near each branch connection and riser takeoff, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.

3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. On all horizontal runs spaced 20 feet maximum but not less than once in each room at entrance and exit of each concealed space.
 7. Where capped piping is provided for future connections, provide legible and durable metal tags indicating symbol identification.
- C. Install plastic pipe markers in accordance with manufacturer's instructions.
- D. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.
- E. In finished areas, label exposed pipes or ducts only as directed by Architect.

3.4 DUCT LABEL INSTALLATION

- A. Provide identification of all toilet exhaust, general exhaust, hazardous exhaust, supply air, return air, and outside air ducts by means of label identifying contents and direction of flow. Hazardous ductwork shall include all grease exhaust
- B. Locations: Provide identification in ducts coming out of shaft at each floor and in equipment rooms and every 10 feet of duct. Provide identification at least once in each room where ducts are concealed and at each access panel.
- C. Locate duct labels where duct is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
1. Within one foot of each control device.
 2. Near each branch connection and riser takeoff, excluding short takeoffs for terminal units. Where flow pattern is not obvious, mark each duct at branch.
 3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
 4. At access doors, and similar access points that permit view of concealed ducting.
 5. Near major equipment items and other points of origination and termination.
 6. On all horizontal runs spaced 20 feet maximum but not less than once in each room at entrance and exit of each concealed space.
 7. Where capped ducting is provided for future connections.
- D. Application: Apply to clean surfaces free of dust, grease, oil or any other material which will prevent paint adhesion.

3.5 VALVE-TAG INSTALLATION

- A. Tag all control valves and valves that are required to be normally open or normally closed for which a manual change by an uninformed party could adversely affect the performance of the system (i.e. bypasses, etc) except riser drains, strainer drains, and valves within factory-fabricated equipment units. List tagged valves in a valve schedule.
- B. Number tags to conform to directory listing number, location and use.

- C. Secure tags to valves with approved corrosion resistant brass "S" hooks.
- D. Tag automatic controls, instruments, and relays. Key to control schematic.

3.6 WARNING TAG AND SIGN INSTALLATION

- A. Provide engraved tag with required message on, and attach warning tags to, equipment and other items where required.
- B. Provide information signs at locations of major equipment where there is hazardous exposure or danger associated with the operation or maintenance of the equipment. Provide text of sufficient clarity and lettering of sufficient size to convey related data at each location. Comply with recognized industry standards for color and design. Text shall be provided or confirmed acceptable by the manufacturer of the equipment.
- C. Furnish warning notice sign outside all rooms, air handler sections, or sheet metal constructions serving as positively or negatively pressurized plenums identifying them as such. Locate sign at each access door. Identify whether positive or negatively pressurized, such as "Warning: Area behind this door is (negatively/ positively pressurized, selected as appropriate). Use caution when opening door."
- D. Furnish warning signs near chemical treatment equipment: "Chemicals present, eyewash and emergency shower to your (left/right as appropriate)."
- E. Furnish warning and instruction signs at Refrigerant Machinery Room doors to support Refrigerant Purge System warning requirements. See also Division 25 Controls Specification.
 - 1. Chiller room outside each door: "Refrigerant Machinery Room. Access by authorized personnel only. Explosive materials present."
 - 2. Chiller room: Identify EPO switches, "Emergency Shut Down".
- F. Furnish warning and instruction signs at boiler room: "Boiler Room. Access by authorized personnel only. Natural gas and flame present."
- G. Furnish signs on grease access doors "ACCESS PANEL – DO NOT OBSTRUCT"
- H. Furnish warning notice at all Pressure Reducing Valves and Safety Valves: "High Pressure Pipe with Safety Relief."
- I. Furnish warning notice at all VFD's and disconnect switches that are part of a smoke control system: "Critical Life Safety Equipment in Smoke Control System: Do Not Leave in off position."

3.7 CONTROLS DEVICE AND ROOM CONTROLS DEVICE LABELING

- A. Thermostats, humidistats, and carbon dioxide sensors within the room shall be labelled as per 2.7.
- B. Coordinate with controls contractor to ensure that all controls devices are labelled in consistent cross reference to the controls points list name for device.

END OF SECTION

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General Conditions and Standard Guidelines referenced in Division 01 Summary Section, apply to this Section. Where conflicts occur between Divisions and Sections, more stringent requirements shall apply.

1.2 SUMMARY

- A. A contractor certified by the Associated Air Balance Council (AABC) or the National Environmental balance Bureau (NEBB) shall be used for the Testing, Adjusting, and Balancing (TAB) process.
- B. Functional Performance Testing and Commissioning of the system shall be performed by the installing party under the oversight of the client's appointed agent. Such performance testing shall include the testing of the sequence of operations for all equipment for part and full load, as well as under normal and emergency conditions. Typical summer, winter, spring, and fall seasons. Monitoring for peak performance, validating peak energy consumption, and sufficient documentation to support the Enhanced Commissioning point within the CHPS process.
- C. Testing and balancing of systems to be in accordance with AABC or equivalent standards by NEBB TAB Contractor to provide services and coordination required to deliver a completely balanced, tested and certified air and water system.
 - 1. Provide services of an air and water balance and testing agency whose business is dedicated to the balancing, adjusting and testing of heating, ventilating, and air conditioning systems.
 - 2. TAB contractor shall review the shop drawings prior to their submission for review and sign off that all necessary balancing devices, measurement stations, and straight length distances are adequate to provide reliable readings and balancing ability in the future.
 - 3. Perform the pressure, leakage, and acoustic testing required.
 - 4. Maintain a list of deficiencies for the General Contractor with review by Owner on demand.
 - 5. Provide all labor, materials, tools and equipment, man-lifts, incidentals and services to carry out the work of this section.
 - 6. Coordinate with the Mechanical Subcontractor and Commissioning Agent.
 - 7. During warranty period, calibrate and adjust controls and re-balance areas as required to maintain satisfactory space requirements.
 - 8. Complete and test all systems early enough to enable completion of balancing prior to owner move-in.
- D. Related Sections:
 - 1. Section 230000 – Basic Mechanical Requirements

2. Section 230800 – Commissioning of HVAC.
 3. Section 230900 – Building Automation System
 4. Division 23 – Sections for equipment subjected to Testing, Adjusting and Balancing.
- E. This Section includes Testing, Adjusting, and Balancing to produce design objectives for the following:
1. Air Systems:
 - a. Constant-volume air systems.
 - b. Variable-air-volume systems.
 - c. Miscellaneous air moving devices.
 - d. Duct leakage testing
 2. Hydronic Piping Systems:
 - a. Variable-flow systems.
 - b. Primary-secondary systems.
 3. HVAC equipment quantitative-performance settings.
 4. Vibration measuring.
 5. Sound level measuring.
 6. Verifying that automatic control devices are functioning properly.
 7. Reporting results of activities and procedures specified in this Section.
- 1.3 REFERENCES
- A. Associated Air Balance Council:
1. AABC MN-1 - National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
- B. American Society of Heating, Refrigerating and Air-Conditioning Engineers:
1. ASHRAE 111 - Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning and Refrigeration Systems.
 2. Fundamentals Handbook
 3. National Environmental Balancing Bureau
 - a. Procedural standard for Testing, Adjusting and Balancing of Environmental Systems.
 - b. Procedural standard for measurement of sound and vibration.
- C. Sheet Metal and Air Conditioning Contractors National Association (SMACNA)
- 1.4 DEFINITIONS
- A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

- B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
- C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
- D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
- E. NC: Noise criteria.
- F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
- G. RC: Room criteria.
- H. Report Forms: Test data sheets for recording test data in logical order.
- I. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
- J. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.
- K. TAB: Testing, adjusting, and balancing.
- L. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.
- M. Test: A procedure to determine quantitative performance of systems or equipment.
- N. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.5 SUBMITTALS

- A. Section 013300 - Submittal Procedures: Submittal procedures and Section 230000 – Basic Mechanical Requirements. Where conflicts occur between divisions, the more stringent requirement shall apply.
- B. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article. If the Contractor fails to submit an acceptable agency within the specified time, owner may select a firm to accomplish the work. Selection is binding upon the Contractor at no increase in contract sum. The submittal shall include:
 - 1. Organization, supervisor and personnel training and qualifications, including registration of certified Test and Balance engineer.

2. List experience of 5 similar type projects and references including Owner, Architect, Consulting Mechanical Engineer and Mechanical Contractor.
 3. A complete list of instruments proposed to be used, organized in appropriate categories, with data sheets for each. Show:
 - a. Manufacturer, model and serial number.
 - b. Description and use when needed to further identify the instrument.
 - c. Size or capacity range.
 - d. Method of calibration (factory or on site).
 - e. Latest calibration date and certificates of calibration.
- C. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit copies of the Contract Documents review report as specified in Part 3. The submittal shall include:
1. The TAB Engineer's marked copy of the construction documents annotated to confirm the locations of the designated flow control and balancing devices. The drawing markups shall also identify the TAB Engineer's preferred location of testing and measurement locations, including requirements with regards to straight lengths of upstream and downstream runs to ensure measurement accuracy.
 2. A set of clearly annotated drawings showing all of the additional balancing devices that are necessary in order to balance the system. Each drawing markup shall contain a summary list of added devices so that the Mechanical Contractor can incorporate this information into the Shop Drawings.
 3. Written summary outline for each air and water system, identifying its associated subsystems and equipment that will require measurement. The document shall note by equipment type the applicable acceptance criteria, tolerances, and special requirements, and it should explicitly note which control devices will need to be used to assist the TAB exercise.
- D. Shop Drawings Examination Report: Concurrent to the submittal of the Mechanical Contractor's Ductwork and Piping Shop Drawings, the TAB contractor shall provide a signed letter confirming that he has reviewed the Shop Drawings, that the locations of all balancing devices and measurement locations have been identified in the Plans, and that they are placed in a location that is accessible and acceptable to ensure accuracy of measurements. If Shop Drawings are submitted in stages, then each submission will require an independent letter from the TAB Contractor.
- E. Strategies and Procedures Plan: Within 30 days from Contractor's Notice to Proceed, submit copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article.
1. TAB submittals shall explicitly define the procedures for the testing, adjusting, and balancing of air handling, refrigeration, hot water, and chilled water piping system equipment as the basis of final acceptance. This shall include design conditions, tolerances, and the data to be obtained and documented in the reports submitted for final acceptance.
 2. Include a complete set of proposed report forms with all design data filled in, specifically intended for use on this Project. Submit systems' plan drawings cross-referencing individual systems to be balanced and balancing devices to the forms.

Submission of generic procedures and forms will be rejected without review.
Highlight any unusual or untraditional approaches.

3. A schedule of work coordinated with other trades and the handover, commissioning, and training schedules of the project.

F. On-site Personnel and Equipment List

1. One month prior to the start of balancing work on site, resubmit resumes of the personnel who will actually perform the work and calibration reports for all of the specific equipment to be used.

G. Preliminary TAB Reports: Submit TAB Reports at 75% completion and 95% completion for review by Owner.

H. Upon completion of the balance, the contractor shall submit a complete report including:

1. Quantity of air handled by each fan by pilot tube traverse
2. Air quantities at each supply outlet
3. Air quantities at each return/exhaust intake
4. For pressurization sensitive rooms, pressurization summary on a room-by-room basis that shows total room supply, total return/exhaust, differential cfm, differential pressure across a closed door, differential pressure across an open door.
5. Total CFM for clean supply filters and for filters half obstructed to simulate fully loaded condition.
6. The temperature rise across the cooling coils with controls locked to call for full cooling. Readings shall include entering and leaving air temperatures, entering and leaving water temperatures, and face velocity and size of coil.
7. The temperature rise across the heating coils with controls locked to call for full heating. Readings shall include entering and leaving air temperatures, entering and leaving water temperatures, and face velocity and size of coil.
8. Noise measurements, performed in accordance with ASHRAE handbook guidelines and only after air balance is complete. The measurements should be performed with HVAC equipment on and HVAC equipment off. Measurements should be reported in octave bands and overall NC rating by space. The NC ratings should comply with those listed in section 230548.
9. Vibration Test on all pumps greater than 3 hp and all fans greater than 3 hp.
10. 10. Flow, temperature, and pressure drop performance of all water-based equipment.
11. Recording of all manufacturer's information, horsepower, voltages and measured amperage at time of balance proving final performance.

I. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1. Submit complete test reports in final form, including design data and measured data.
2. Submit a set of reduced drawings with air outlets, valves, devices, measurement locations and equipment identified to correspond with data cross-referencing individual balanced and balancing devices and indicating sensor locations. The drawings shall denote the required and actual air quantities recorded at each outlet and inlet.

3. Submit fan curves with design and actual operation points plotted.
 4. Submit duct system pressure profiles.
 5. Submit a summary report describing any component or system which does not function properly and in what state the item was left.
 6. Furnish reports in letter size, 3-ring binder manuals, complete with table of contents page and indexing tabs laid out for each system and test type, with cover identification at front and side.
- J. Warranties specified in this Section.
- K. Weekly Field Deficiency Reports identifying deficiencies in the installed work or problems that have occurred during the balancing exercise as well as items listed in "Examinations" specified in Part 3 of this Section. These must be submitted to the Owner.
- L. Onsite Random Testing: Facilitate re-measurement as witnessed by the Owner to backcheck values on devices selected by the Owner versus TAB report for up to the following quantities (with a minimum number of tests per device type equaling one)
1. 10% of diffusers or grilles
 2. 20% of air handling units
 3. 20% of pumps
 4. 20% of terminal air side and hydronic equipment.
- M. Closeout Submittals
1. Division 1- Execution and Closeout Requirements: Requirements for submittals.
 2. Comply with requirements for formatting from Division 1.
 3. Project Record Documents: Record actual locations of flow measuring stations, balancing valves and rough setting.
 4. Operation and Maintenance Data: Furnish final copies of testing, adjusting, and balancing report for inclusion in operating and maintenance manuals. This shall be the final copy denoted as "No Exception Taken."
- 1.6 QUALITY ASSURANCE
- A. TAB Firm Qualifications: Engage a TAB firm certified by AABC. All work shall be under the supervision of a qualified heating and ventilating engineer employed by them. TAB Technicians shall have a minimum of 3 years' experience and shall be certified by AABC or. TAB Supervisors shall have a minimum of 5 years' experience and shall be certified by the Associated Air Balance Council (AABC). to provide proof of having successfully completed at least five projects of similar size and scope. All work shall be carried out under the supervision of the approved TAB technicians. The TAB firm shall submit certification of their current membership of AABC. All instruments used by this agency shall be accurately calibrated and maintained in good working order. Acceptable contractors include American Air Balance Co. Inc., Los Angeles Air Balance Company, Inc., Penn Air Control, or approve AABC-certified equal.
- B. TAB Conference: Meet with Owners on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls

installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
 - a. Submittal distribution requirements.
 - b. The Contract Documents examination report.
 - c. TAB plan.
 - d. Work schedule and Project-site access requirements.
 - e. Coordination and cooperation of trades and subcontractors.
 - f. Coordination of documentation and communication flow.
 - C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.
 3. The TAB Contractor shall provide an AABC Certificate of Conformance Certification (issued by AABC national office) for all work specified to confirm that the work has been carried out in accordance with the applicable AABC Standards and Procedures, and the provisions of AABC Quality Assurance Conformance Certification Rules of Procedures.
 - D. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems, Adjusting, and Balancing of Environmental Systems" with project specific augmentation as appropriate.
 - E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.
 - F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.
- 1.7 PROJECT CONDITIONS
- A. Testing and balancing of systems to be the final step of construction after all other work is complete. All equipment start up shall have been completed by the manufacturer's representative and documented on the commissioning agent's "Pre-Functional Test" forms. Work shall be so coordinated with control work so that controls are set and adjusted for the balanced system and the balance is realized with controls in adjustment.
 - B. System Readiness:
 1. The building envelope must be complete. All windows, doors, insulation, internal sheet finishes (such as gypsum wall board), cladding curtain walling, etc., must be installed so that the full specified performance of the envelope is achieved.

2. The specified system being tested and balanced must be complete. Balancing of partially completed systems will not be acceptable. Sub-systems may be tested and balanced separately. A mechanical sub-system is an air handling unit or fan together with its associated ductwork, terminal units, dampers, grilles and diffusers. Fans that operate together, such as AHU supply and return fans, or ventilation supply and exhaust fans serving common area shall be tested together as a common mechanical sub system.
3. The system must be running fault free.
4. Pressure testing and leak testing must be satisfactorily complete.
5. Pre-Balancing Deficiency Notification: Promptly report any installation deficiencies in weekly deficiency reports during the Pre-balancing Examination work.
6. Preliminary acceptance of installed work: The TAB Contractor shall notify the Owner in writing to document which portions of the installed work he is ready to accept as complete and operational for the start of the balancing exercise. This should clearly identify which systems can be balanced and any adverse risks associated with the balance of incomplete work.

C. Prior to start of testing, adjusting and balancing:

1. Systems installation to be complete and in full operation.
2. All filters shall be replaced and all strainers shall be cleaned by the mechanical subcontractor.
3. The TAB contractor shall investigate and report upon the adequacy of the dampers and of provisions for instrumentation and control, and shall balance the air and hydronic systems to within 5% of quantities called out on the engineering drawings.
4. It shall be the responsibility of the air balance contractor to re-sheave fans or trim pump impellers to achieve the flow rates, efficiencies or pressurization relationships indicated on the drawings. This will be considered part of the contract at no additional cost to the owner.
5. The tests shall be conducted in the presence of the authorized agent of the owner, using mutually approved techniques, and approved instruments, factory calibrated within 6 months prior to the test.
6. Setting the charging pressure of the expansion tanks shall be the responsibility of the TAB contractor.
7. When noise from the HVAC system does not meet levels required in the documents, as tested by the TAB contractor, the contractor shall rebalance or adjust HVAC equipment casing noised in excess of design NC limit. Re-measure sound levels in all such spaces to show compliance with NC limits. Repeat until noise level meet guidance.
8. Outside conditions to be within 15 degrees of cooling or heating design conditions, depending on which system is being tested.
9. Building lights shall be turned "on" when balancing cooling system, "off" when balancing heating system.
10. Special equipment such as computers, laboratory equipment, electronic equipment or engine generator to be in full operation, or a heat load proxy has been put in place to test HVAC capacity.
11. Close all windows and doors.

- D. If the season during which the TAB report is generated has insufficient outdoor air conditions to allow the full capacity of the heat-transfer coils to be proven, the owner may request at no cost to the project that the TAB contractor either provide temporary artificial cooling/heating sources to prove capacity or at the institute's discretion, require that the TAB contractor return at an owner prescribed time in the next peak season to re-measure performance.
- E. The TAB contractor shall denote deficiencies in performance or in mechanical installation as compared to construction documents and report this on a weekly basis in a written report format to the owner's designated agent. Promptly report any installation deficiencies found during the Balancing exercise to the General Contractor directly, including identifying systems that appear to be having trouble achieving balance and identify what will be done to rectify these deficiencies.

1.8 COORDINATION

- A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.
- B. Coordinate with the Construction Manager to produce a complete schedule for the TAB work including identifying all other aspects of the construction work by other trades upon which successful completion of the TAB work depends. All such dependencies shall be identified to allow proper sequencing of the required work. This schedule shall be prepared using the same computer software as the construction manager's schedule such that it can be added to the construction manager's schedule. Schedule shall be kept up-to-date. The schedule shall show, as a minimum:
 - 1. Itemize all systems to be made operational, tested and balanced.
 - 2. Identify the dates that system construction, cleaning, pressure testing and pre-testing will be completed.)
 - 3. Identify interdependencies between systems that impact the TAB work. (For example, the heating system cannot be considered complete until the associated electrical power system and controls system are complete.
 - 4. Identify each trade affected by and required for the TAB to ensure that the adequate time for their work is scheduled.
 - 5. Identify the beginning and end of the TAB work for each building system.
 - 6. All submittal dates for first, second, etc., submittals shall be clearly identified on the schedule. Required review and re-submittal dates shall also be included.
 - 7. Requirements for tests and inspections required by AHJ and schedule for inspections completion, submission, and approval.
 - 8. Include dates for training of Owner's staff.
- C. Notice: Provide seven days' advance notice for each test requiring witnessing. Include scheduled test dates and times.
- D. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

- E. Coordinate with the work of Division 25 to determine positions of all dampers and control valves in accordance with the outlined sequences of operation.
- F. In the event the TAB Contractor fails to coordinate with any party and costs are incurred for testing or retesting by any party as a result of this failure to coordinate, then the TAB Contractor shall be responsible for these costs.
- G. The TAB Contractor's Project Manager shall attend regular commissioning meetings as required by the Construction Manager.

1.9 SCHEDULING

- A. Schedule a Shop Drawing review during the HVAC Shop Drawing submittal process
- B. Schedule balancing work between the completion of systems tested and the Date of Substantial Completion, taking into account the schedule for the Commissioning Fractional Test Procedures, which cannot begin until TAB is complete.
- C. Schedule and provide assistance in final adjustment, verifying measurements, and test of smoke control system with Fire Authority.
- D. Schedule and provide assistance in final adjustment of control system's flow and temperature set points.
- E. Schedule and provide support to Commissioning Team for acquisition of measurements during Pre-Functional checklists and Functional tests. Testing, Adjusting, and Balancing shall be the final step of Construction prior to Commissioning, and it should occur after all other work is completed and the facility is cleaned.

1.10 WARRANTY

- A. Provide one of the following warranties:
 - 1. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
 - a. The certified TAB firm has tested and balanced systems according to the Contract Documents.
 - b. Systems are balanced to optimum performance capabilities within design and installation limits.
- B. During the warranty period of one year following substantial completion of TAB, seasonal testing and other deferred testing required shall be completed. The TAB firm shall coordinate this activity with the Owner and CM.
 - 1. Approximately six months after completion of the TAB, the TAB firm shall return to the project site for Seasonal Testing and carryout a 72-hour run test of the complete building systems as described above. All sensors, devices, etc., shall be trended for

this period and presented in graphical format at a useful resolution. The TAB firm shall make any adjustments necessary to the system to ensure all systems and systems components are operating in a correct manner and that design conditions are being maintained within the building without hunting. See also Part 3 of this Section.

2. In addition the TAB firm will return to the project approximately 10 months into the warranty period. During this visit(s) the TAB firm will review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning. The TAB firm will also interview facility staff and identify problems or concerns they have operating the building as originally intended. The TAB firm will make suggestions for improvements and will record these changes in the O&M manuals.
3. Deferred Testing: any system or item that cannot be properly tested during the construction period, due to, for example, weather conditions, shall be tested and balanced as far as possible. The TAB process shall be completed when conditions are favorable.

1.11 ADDITIONAL DEFERRED TESTING:

- A. When all TAB and commissioning work has been carried out, the building systems will be run in full automatic mode for a minimum period of 72 hours. All FMS sensors, devices, etc., shall be trend logged every minute and presented in a graphical format at a useful resolution. Final acceptance of the building systems will be contingent upon the system maintaining conditions within design tolerances without hunting for all of the 72 hours.
- B. If the systems do not run in a stable manner and the Owner requires TAB measurements to be repeated to help with troubleshooting this shall be provided under this contract scope for four additional man days of measurement and verification.

PART 2 - PRODUCTS

2.1 SHEAVES, BELTS AND IMPELLERS

- A. It is the responsibility of the TAB contractor to highlight to the mechanical contractor that they should provide replacement sheaves and belts in order to achieve final balance in the event that the existing sheaves do not allow sufficient adjustment. Notification of the change shall be raised to the owner with documentation of the reasons why it is being pursued. Sheaves and belts shall be provided in accordance with the equipment manufacturer's recommendations. A letter of guarantee from the manufacturer shall be obtained for each instance of a change to state what the change was, that the sheave change is acceptable to the manufacturer and that it does not void the warranty. This letter shall be submitted for the Operations and Maintenance Manual as a clarification to the equipment warranty.
- B. It is the responsibility of the TAB contractor to highlight to the mechanical subcontractor that they should provide replacement impellers or trim the existing impellers in a piece of installed equipment in order to achieve final balance in the event that the existing systems do not allow for sufficient adjustment. Notification of the change shall be raised to the owner with documentation of the reasons why it is being pursued. Trimming of impellers shall be performed by a party pre-approved by the equipment manufacturer. A letter of

guarantee from the manufacturer shall be obtained for each instance of a change to state what the change was, that the change is acceptable to the manufacturer and that it does not void the warranty. This letter shall be submitted for the Operations and Maintenance Manual as a clarification to the equipment warranty.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment. Review plans and specifications prior to installation of any of the affected systems. Prepare a schedule to inspect air and water systems and equipment. Submit written report with suggestions for work to be performed or devices added to allow for proper balancing. Added devices are at no increase in contract sum.
 - 1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
 - 2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents and present in the Shop Drawings. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.
 - 3. The lead TAB technician shall visit the job a minimum of three times during the early stages of construction to review the installation. Submit written report with suggestions for work to be performed or devices added to allow for proper balancing. Submit report to the Owner listing any deficiencies found that would preclude proper adjusting, balancing and testing. This technician shall verify that Work, fittings, dampers, balancing devices, etc. are properly fabricated and installed as specified or shown and that proper balancing can be done.
- B. Make field inspection prior to closing in portions of systems to be balanced. Verify that the Work, fittings, dampers, balancing devices, etc., are properly fabricated and installed as specified or shown and that proper balancing can be done.
- C. Examine approved submittal data of HVAC systems and equipment.
- D. Examine Project Record Documents described in Division 01 Section "Project Record Documents" To ensure all TAB devices and final approved values are recorded.
- E. Examine design data, including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- F. Examine equipment performance data including fan curves. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts

found in AMCA 201, "Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

- G. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.
- H. Examine filters to ensure that all specified filters are installed and clean. If required to protect unit cleanliness from ongoing construction dust, install protective temporary media in addition to the filters.
- I. Examine system and equipment test reports.
- J. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.
- K. Examine fans to confirm that they are rotating properly.
- L. Examine duct systems to confirm that they are clean of debris.
- M. Examine air coils to confirm that the fins are clean and combed.
- N. Examine ductwork to ensure that access doors are closed and that duct end caps are in place.
- O. Examine ductwork to ensure that air outlets are installed and connected.
- P. Examine the results of the duct leakage test to confirm that the system complies with the contract documents.
- Q. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.
- R. Examine HVAC equipment to ensure that clean filters have been installed, coils, fans, dampers, plenums, ducts, etc., are sealed and clean, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- S. Examine all electrical equipment to confirm that proper thermal overload protection is in place.
- T. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
- U. Examine strainers for clean screens and proper perforations.
- V. Examine heat-transfer coils for correct piping connections and for clean and straight fins.
- W. Examine equipment for installation and for properly operating safety interlocks and controls.

- X. Examine automatic temperature system components to verify the following:
1. Dampers, valves, and other controlled devices are operated by the intended controller.
 2. Dampers and valves are in the position indicated by the controller.
 3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes all motorized dampers, valves, and actuators in all air handling devices, mixing boxes, and variable-air-volume terminals.
 4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
 5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
 6. Sensors are located to sense only the intended conditions.
 7. Sequence of operation for control modes is according to the Contract Documents.
 8. Controller set points are set at indicated values.
 9. Interlocked systems are operating.
 10. Changeover from heating to cooling mode occurs according to indicated values.
 11. Sensors have proof of calibration.
 12. The point-to-point check has been completed.
- Y. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREBALANCING REQUIREMENTS

- A. Advise Owner in writing when systems have been completed and tested and are ready for balancing. Signoff by all manufacturer's representative start-up technicians shall be complete as documented on the Commissioning Pre-Functional Testing report.
- B. Submit report on measured CFM, GPM, RPM, AMPS, inlet and outlet pressures of all equipment after testing and before balancing by Balancing Contractor.
- C. Complete, perform and coordinate with other contractors the following Work prior to commencement of the balancing procedure.
1. Complete testing of systems.
 2. Prior to the start of balancing, complete punch list items that will affect balancing of the system. Coordinate with Contractor to have all devices installed at no increase in contract sum.
 3. Mechanical Contractor to install dampers and other balancing devices shown, specified, and required. Check to be sure they are properly installed, indexed, and in good working order.
 4. Schedule the Work of other trades to eliminate system shutdown for any reason once balancing is started.
 5. Schedule the Work of other trades to assure uninterrupted access to mechanical equipment rooms as well as conditioned spaces.
 6. Provide labor and material necessary to perform any system revisions required to allow completion of balancing.

7. Lubricate all equipment in accordance with manufacturer's instructions.
8. Place systems in automatic operation.
9. Operate the systems for 72 consecutive hours without shutdown with equipment in perfect working order.
10. Check all motor starters to confirm heater size is correct. Take length of electrical feeder into consideration.

D. Air systems:

1. Align drives.
2. Set sheaves to provide indicated capacities at specified static pressures.
3. Set manual dampers to 100 percent open position.
4. Check all damper operations to ensure smooth, free activation by the proper controls.
5. Remove adjustable pitch pulleys from motor shaft; clean and lightly oil shaft and pulley threads; and remount, align and properly adjust pulley.
6. Drill 3/8-inch diameter holes in low velocity ductwork with burrs removed, for temperature, pressure and velocity readings; and provide holes in drive guards that will permit tachometer readings without removing guards. Locate as specified hereinafter and as directed. Install replaceable rubber plug in each hole.
7. Clean interior of plenums, casing, coils and ducts; and install temporary and final filters before starting any systems.
8. Drill test holes in the following locations: Each side of each filter, fan, coil and multi-blade damper; 12 inches on center for traverse readings in main ducts and as directed in the field. Turn at least ten extra plugs over to the Owner for use during balancing period.

E. Water systems:

1. Set balancing cocks to 100 percent open position.
2. Remove, clean and replace strainer screens, vent air from piping, verify proper operation of automatic air vents.
3. Position normally open valves full open.
4. Examine water in system to determine if water has been treated and cleaned.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system readiness checks and prepare system readiness reports. Verify the following:
1. Permanent electrical power wiring is complete.
 2. Hydronic systems are filled, clean, and free of air.
 3. Automatic temperature-control systems are operational.
 4. Equipment and duct access doors are securely closed.
 5. Balancing, smoke, and fire dampers are open.
 6. Isolating and balancing valves are open and control valves are operational.
 7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.

8. Windows and doors can be closed so indicated conditions for system operations can be met.
- C. Furnish instruments required testing, adjusting, and balancing operations.
 1. Make instruments available to the Architect/Engineer to facilitate spot checks during testing.
 2. Provide proof of calibration for all instruments used on the project.

3.4 PRELIMINARY TESTING

- A. The Mechanical Contractor will carry out a series of preliminary tests prior to the commencement of the TAB work of this contract. The intent of these tests is to demonstrate that the equipment operates properly in all modes. The TAB Contractor shall review these test reports and shall record from these reports any data required to carry out the work of this contract.
- B. The Mechanical Contractor shall, as a minimum, carry out the tests, procedures and checks recommended by the equipment manufacturer and shall use the services of equipment manufacturer representatives to ensure the successful start-up and correct operation of all systems and equipment.
- C. The TAB Contractor shall witness the above work and submit a deficiency report for any incomplete work that will affect the work of this Contract.
- D. The TAB Contractor shall review and report on the following, as a minimum:
 1. Installation of equipment.
 2. Installation of devices
 3. Completeness of the ductwork and pipework installation.
 4. Installation of access doors or other access provisions for balancing devices, fire and smoke dampers.
- E. The TAB Contractor shall issue reports weekly during the Mechanical Contractor's preliminary testing process. Any major deficiencies shall be reported daily.
- F. The TAB Contractor shall witness the Mechanical Trade Contractor's ductwork leakage and pipe pressure tests, and sign the results.
- G. At the end of the Mechanical Contractor's testing, the TAB contractor shall submit in writing a letter confirming that the installation is complete, tested and operational, and that the systems are ready for balancing.

3.5 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems.

- B. Test Balance Service: Perform analysis, test and balance services upon completion of air and water systems, after completion of general operating tests, Pre-balancing Requirements and after the Work specified above.
- C. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.
- D. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.
- E. Take readings as shown, specified and as required to demonstrate that all equipment terminal devices, controls, etc. are operating in accordance with scheduled or manufacturer's published ratings.
- F. Make adjustments and/or corrections to equipment, air systems necessary for proper balancing.
- G. Perform capacity checks of heating systems during the balancing period and again during design condition the following winter. Perform capacity checks for cooling systems during the balancing period and again during design the following summer.
- H. Operating tests of heating and cooling apparatus, fans, and other equipment to be of not less than four hours duration, after stabilized operating conditions have been established. Capacities to be based on temperatures, air and water quantities measured during such tests.
- I. Take and report testing and balancing measurements in inch-pound (IP) units.
- J. The specified systems shall be reviewed and inspected for conformance to the design documents. Testing, adjusting and balancing on each system shall be performed. The accuracy of measurements shall be in accordance with AABC Standards. See below for tolerances on measured quantities.
- K. Any deficiencies in the installation or performance of a system or component shall be reported in writing to both the Mechanical Trade Contractor and Consultant.
- L. Should the results of balancing indicate that a mechanical system does not provide the design intent performance, then the Consultant, the Mechanical Contractor and the TAB Contractor shall review the results. The Consultant shall approve any corrections that are to be made by the Mechanical Contractor.
- M. Should the results of balancing indicate that particular equipment does not provide the design intent performance then the Mechanical Contractor shall repair or replace the equipment. The TAB Contractor shall retest the equipment.

3.6 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" duct layouts for use in recording measurements. Diagram shall show all equipment components and be cross-referenced to the TAB forms and reports.
- C. Determine the best locations in main and branch ducts for accurate duct airflow measurements.
- D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path and proper operation. For automatic dampers, fan speeds, etc., work with controls contractor to establish and set required positions and values to maintain design airflow for different operating conditions specified.
- H. Check for airflow blockages and resolve.
- I. Check condensate drains for proper connections and functioning.
- J. Check for proper sealing of air-handling unit components.
- K. Check for proper sealing of air duct system.
- L. Performances and Capacity Checks:
 - 1. Take readings as shown, specified and as required to demonstrate that all equipment, coils, terminal devices, controls, etc. are operating in accordance with scheduled or manufacturer's published ratings.
 - 2. Recommend adjustments and/or corrections to equipment, air and water systems necessary for proper balancing. Submit report to Owner.
 - 3. Provide each automatic control valve with a permanent brass tag stamped with the following information: valve model number, size and Cv.
 - 4. Perform capacity checks of heating systems during the balancing period and again during a design day the following winter. Perform capacity checks for cooling systems during the balancing period and again during a design day the following summer.
 - 5. Operating tests of heating and cooling coils, fans and other equipment to be of not less than four hours duration, after stabilized operating conditions have been established. Capacities to be based on temperatures, air and water quantities measured during such tests.

M. Air Balancing:

1. Adjust all air handling systems to provide the required design air quantity to, or through, each component, taking into account site altitude. Keep doors and windows closed and all other ancillary systems in simultaneous operation. Balance under normal traffic conditions.
2. Balancing between runs (submains, branch mains and branches): Use flow regulating devices at, or in, the divided-flow fitting to the extent that adjustments do not create objectionable air motion or sound. Minimize restriction imposed by flow regulating devices, in, or at, terminals.
 - a. Air Measurements and Balancing:
 - b. Except as specifically indicated herein, make Pitot tube traverses to measure air flow. Pitot tubes, associated instruments, traverse and techniques to conform with the ASHRAE Handbook Fundamentals. Readings from control system's flow measurement stations only are not acceptable. Report should include both the flow station reading and the actual measurement from the traverse.
 - c. Pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 500 cfm. In lieu of Pitot-tube traverse, determine air flow in the duct by totaling volume of individual terminals served, measured as described herein.
 - d. Where duct's design velocity and air quantity are less than 800 (fpm/cfm), air quantity may be determined by measurements at terminal served.
3. Test holes, ventlock type, to be in a straight duct, as far as possible downstream from elbows, bends, take-offs and other turbulence generating devices, to optimize reliability of flow measurements.
4. Use measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, only for balancing. Determine measurement of air quantities at each type of air terminal (inlet and outlet) by the method approved. Adjust air quantities to following tolerance:
 - a. Supply Diffuser, 0 to +10% of design.
 - b. Return air, +/- 5% of design.
 - c. Exhaust, 0 to -10% of design.
 - d. Equipment, Fans: 0 to plus 5 percent.
 - e. Temperature readings: Within ½ degree F.
 - f. Equipment Pressure drops readings: Within 0.10 inch W.G.
 - g. Space pressure readings: Within 0.05 inch W.G.
 - h. Under no circumstances can room pressure relationships change from that shown on drawings or required by code, even if within specified tolerances (i.e. neutral pressure room cannot become negative or positive. etc.), document to show that intended room pressurization with regard to adjacent space has been achieved.
 - i. Take sample velocity and temperature readings throughout the space in order to confirm uniform space temperatures free from objectionable drafts.
 - j. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

- N. Final Measurements of Air Quantity: Make final measurement of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion. Adjust all diffusers and registers to eliminate drafts in all areas and result in uniform distribution.
- O. Verify that ductwork, dampers, grilles, registers and diffusers have been installed per design.
- P. Balance air handling systems at minimum outdoor air quantities. On completion of balancing procedures, retest at maximum outdoor air quantities.
- Q. Test and record motor voltage and amperage. Compare data with nameplate limits.
- R. Perform pitot tube traverse at all main and branch ducts. Compare traverse total with measured outlet total to determine actual duct leakage.
- S. Test and adjust minimum outdoor and relief air volumes.
- T. Test and record system static pressure profile for each air handling system at minimum outdoor air volume. Note coil (i.e. wet/dry) and filter condition of time of testing.
- U. Test and record entering and leaving air conditions for each heat transfer coil and device. Simulate conditions to achieve winter or summer design patterns.
- V. Test and record settings of motor thermal overload devices. Adjust settings where required.
- W. Verify air flow measurement at all airflow monitoring stations. Coordinate positioning of dampers with the Automatic Temperature Controls Trade Contractor and the air monitoring station manufacturer.
- X. Verify minimum outside air flow requirements. As part of balancing procedures, set fresh air and return air dampers to put the entire system into operating balance as shown and required. Coordinate damper position with the Automatic Temperature Controls Trade Contractor.
- Y. Make allowance for air filter resistance at time of tests. Main air supplies shall be at design air quantities and at air resistance across the filter bank midway between the design specifications for clean and dirty filters (i.e., make allowances for 50 percent loading of filters).
- Z. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan.
- AA. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- BB. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- CC. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

- DD. Measure room differential pressures with respect to adjacent rooms and adjust supply, return and exhaust air systems to maintain the differential flows required by the Drawings.
- EE. Adjust duct distribution to obtain specified air quantities. At least one zone balancing damper shall be completely open. Multi diffuser/grille branch ducts shall have at least one volume damper completely open. First utilize main dampers, then branch dampers. Use dampers behind grilles only as a final adjustment.
- FF. Adjust control sequence, setting, and operation of automatically controlled dampers for normal operating conditions. Plainly mark final position of manual dampers after balancing is complete. Perform air-terminal readings in accordance with the recommendations of the air device manufacturer. Set and lock memory stops.
- GG. Take duct and outlet readings with Anemotherms or Alnor velometers. Take readings on large air intakes, coil banks and filter banks with anemometer. Take static pressure readings with Dwyer U-tube manometer No. 400 or equal. Electrical current readings to be made with clamp-on type ammeter.
- HH. Provide positive identification points of measurements such as a marked print.
- II. Tabulated fan capacity may exceed summation of register and diffuser readings. Leakage allowance as specified in Section 233100 – HVAC Ducts.
- JJ. Mechanical Contractor provide additional dampers and pressure plates where required to facilitate balancing and to prevent damper, grille and diffuser noise. Provide at no increase in Contract Sum.
- KK. Check and adjust fan rpm to design requirements and record fan motor amperes.
- LL. Test, adjust and record system static pressures, suction and discharge ducts.
- MM. Test and adjust system for design, supply, recirculated, outside and exhaust air, cfm.
- NN. Use manufacturer's ratings on all equipment to make required calculations.
- OO. Adjust all diffusers and registers to eliminate drafts in all areas and result in uniform distribution.
- PP. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.
- QQ. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, capping traverse testing points, and restoring setpoints and controls to specified settings. Check and adjust systems twice after acceptance and submit report to prove full capacity of heat transfer coils at extreme outdoor air conditions. This shall be part of the contract at no additional cost to the owner. Schedule access with the Owner.
- RR. Verify leakage tests of all ductwork in accordance with paragraph titled, "Leakage Test" in Section 233100 – HVAC Ducts.

- SS. Make any adjustments to or change-out of the pulleys, belts, axial fan blade pitch and dampers, or the addition of dampers required for correct balance, to achieve the flow rates, efficiencies, or pressurization relationships indicated on the Drawings. This work shall be performed at no additional cost. RPM shown on drawings are for guidance only.
- TT. After final inspection, recheck random selections of data recorded in the report. Recheck points or areas as selected and witnessed by the Owner.
- UU. It is the TAB contractor's responsibility to provide to the controls contractor the balanced static pressure measurements at the control system static pressure sensors controlling variable volume systems. This will be used as a setpoint.

3.7 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
 - 1. Measure fan static pressures to determine actual static pressure as follows:
 - a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.
 - b. Measure static pressure directly at the fan outlet or through the flexible connection.
 - c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.
 - d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
 - 2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
 - a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
 - 3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.
 - 4. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.
 - 5. Obtain approval from Owner's Representative for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Provide sheaves and belts for a minimum of one change per fan.
 - 6. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

- B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
 - 1. Measure static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
 - a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
 - 2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.
- C. Measure terminal outlets and inlets without making adjustments.
 - 1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.
- D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
 - 1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
 - 2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.8 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

- A. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
 - 1. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 - 2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.
 - 3. Measure total system airflow. Adjust to within indicated design airflow tolerances.
 - 4. Set terminal units at required airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.
 - 5. Test and record the amplified velocity pressure signal and inlet static pressure for each terminal unit.

6. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
7. Record the final fan performance data.
8. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes. Coordinate with mechanical subcontractor. Provide sheaves and belts for a minimum of one change per fan.
9. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in all operating modes to determine the maximum required brake horsepower.

3.9 PROCEDURES FOR MISCELLANEOUS AIR SYSTEMS

A. Fan Coil Units:

1. Ensure unit and associated controls are functioning properly.
2. Verify fan volumes match manufacturer's performance values.
3. Verify fan performance through airside temperature measurement at design speed.

B. Exhaust Systems:

1. Test and balance all building exhaust systems using the requirements given above for the variable or constant air volume systems as relevant.
2. Record static pressure profile, and current draw and rpm for each fan system.

3.10 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

- A. Prepare test reports with pertinent design data and number in sequence from start to end of system. Check the sum of branch-circuit flows against approved flow rate. Correct variations that exceed 0 to plus 5 percent of design. Temperature to be within 2°F of design value.
- B. Prepare schematic diagrams of systems' "as-built" piping layouts for use in recording measurements. Diagrams shall show all components and be cross-referenced to the TAB forms and reports.
- C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:
 1. Open all manual valves for maximum flow.
 2. Check expansion tank liquid level.
 3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
 4. Check flow-control valves for specified sequence of operation and set at indicated flow.
 5. Check flow rates through each pressure independent flow control valve and confirm it is in accordance with manufacturer's selection data.

6. Set system controls so automatic valves are wide open to heat exchangers.
 7. Check air vents for a forceful liquid flow exiting from vents when manually operated.
- D. Check and adjust if necessary the settings on all pressure and safety relief valves.
- E. The specified systems shall be reviewed and inspected for conformance to the design documents. Testing, adjusting and balancing on each identified system shall be performed. The accuracy of measurements shall be in accordance with AABC Standards. See below for tolerances on measured valves.
- F. Adjust all hydronic systems to provide required quantity to, or through, each component.
- G. Adjust water quantities to the following tolerance:
1. Water flow: 0 to +5 percent of design.
 2. Pumps: 0 to 10 percent of design.
 3. Temperature: within 1/2-percent F.
 4. Pressure: within 1/2-percent psi.
- H. Balance hot water coils after balancing multiple coil sections for even water distribution through tubes.
- I. The testing agency shall perform the following test and adjustments upon completion of preparation and initial test:
1. Read pressure drop through coils at set flow rate on call for full cooling or heating.
 2. Measure water quantities and pressures with calibrated meters, if applicable:
 - a. Water measurements and balancing: Use venturi tubes, orifices or other metering fittings and pressure gages. Adjust systems to provide the approved pressure drops through the heat transfer equipment (coils, etc.), prior to the capacity testing.
 - b. Where flow metering fittings are not installed, determine flow balance by measuring temperature differential across the heat transfer equipment. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.
 3. Position automatic control valves for full flow through heat transfer equipment of the system during tests.
 4. Adjust flow through by-pass circuits at three-way valves to balance that through the supply circuit.
 5. Adjust distribution by means of balancing devices (cocks, valves and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only pressure drop across the valves if said pressure drop is within the pressure drop rating.
 6. Assure that all modulation control valves provide full throttling from wide open (design) flows to 100 percent shut-off. Verify control sequences, settings and operation to all automatic control valves.
 7. Lock set points and plainly mark final position of all balance valves after balancing is complete. Read and record data.

8. Utilize thermometer wells, time-quantity devices and other line flow-measuring devices specified. In closed systems, where no line devices are installed, use a surface pyrometer probe.
9. Where pyrometers are used, tabulate surface temperature differentials between inlet and outlet of heat exchange devices. Pyrometers shall be Alnor Type 4200, scale 0-degrees to 500 degrees F, with a 2 degree F graduations and appropriate pipe probe.
- J. Should the results of balancing indicate that a mechanical device does not provide the design intent performance, then the Consultant, the Mechanical Contractor and the TAB Contractor shall review the results. The Consultant shall approve any corrections that are to be made by the Mechanical Contractor.
- K. Should the results of balancing indicate the particular equipment does not provide the design intent performance then the Mechanical Contractor will repair or replace the equipment. The TAB Contractor shall retest the equipment.
- L. Test and adjust system feeders to ensure adequate system static pressure is available under all operating conditions.

3.11 PROCEDURES FOR HYDRONIC SYSTEMS

- A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:
 1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size. Trim or change pump impellers to deliver the flow at the lowest actual total system head pressure. Pumps shall be free of cavitation and vibration.
 2. Check system resistance and flow rate. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved. Compare to design value and determine reasons for any difference found.
 3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
 4. Report flow rates that are not within plus or minus 5 percent of design.
 5. Where available pump capacity is less than the sum of the component flow requirements, simulate full flow in one part of the system by temporary restriction of flow to the other parts.
- B. Set calibrated balancing valves, if installed, at calculated presettings.
- C. Test and adjust (where adjusting devices are provided) water flow to all hydronic equipment to obtain the specified flow.

1. Use calibrated fittings and pressure gauges to determine flow rates for system balance. Readings from control system's measurement stations alone is not acceptable. Provide control sensor reading for reference.
 2. Confirm flow rate and pressure drop at each pressure independent control valve. Compare actual equipment water side pressure drops with manufacturer's published data. Measure flow at all stations and adjust, where necessary, to obtain first balance.
 3. Perform system balance with automatic control valves fully open or in normal position to heat transfer elements. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.
- D. Set HVAC system water flow rates within the following tolerances:
1. Heating-Water Flow Rate: 0 to minus 10 percent.
 2. Cooling-Water Flow Rate: 0 to minus 5 percent.
 3. Condenser Water Flow Rate: 0 to minus 5 percent.
- E. Where equipment is used for heat transfer to air measure entering and leaving liquid and air conditions and compare to manufacturer's published data.
- F. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.
- G. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:
1. Determine the balancing station with the highest percentage over indicated flow.
 2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.
 3. Record settings and mark balancing devices.
- H. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.
- I. Measure the differential-pressure control valve settings existing at the conclusions of balancing.
- J. Verify control of differential pressure using pumps and pump by-pass valve.
- K. Adjust pump differential pressure controllers set points to achieve required flow in all branches of the circuits.
- L. It is the TAB contractor's responsibility to set the final charge on the expansion tank.
- 3.12 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS
- A. Balance systems with automatic two- way control valves by setting systems at maximum flow through heat-exchange terminals and proceed as specified above for hydronic systems.

3.13 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

- A. Balance the primary system first, then balance the secondary system.

3.14 PROCEDURES FOR MOTORS

- A. Motors: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.15 PROCEDURES FOR BOILERS

- A. If hydronic, measure entering- and leaving-water temperatures and water flow.

3.16 PROCEDURES FOR HEAT-TRANSFER COILS

- A. Heating and Cooling Coils: Measure the following data for each coil:
 - 1. Entering- and leaving-water temperature.
 - 2. Water flow rate.
 - 3. Water pressure drop.
 - 4. Dry-bulb temperature of entering and leaving air.
 - 5. Wet-bulb temperature of entering- and leaving-air for cooling coils.
 - 6. Airflow.
 - 7. Air pressure drop.

3.17 PROCEDURES FOR COMMERCIAL KITCHEN HOODS

- A. Measure, adjust, and record the airflow of each kitchen hood. For kitchen hoods designed with integral makeup air, measure and adjust the exhaust and makeup airflow. Measure airflow by duct Pitot-tube traverse. If a duct Pitot-tube traverse is not possible, provide an explanation in the report of the reason(s) why and also the reason why the method used was chosen.
 - 1. Install welded test ports in the sides of the exhaust duct for the duct Pitot-tube traverse. Install each test port with a threaded cap that is liquid tight.
- B. After balancing is complete, do the following:
 - 1. Measure and record the static pressure at the hood exhaust-duct connection.

2. Measure and record the hood face velocity. Make measurements at multiple points across the face of the hood. Perform measurements at a maximum of 12 inches (300 mm) between points and between any point and the perimeter. Calculate the average of the measurements recorded. Verify that the hood average face velocity complies with the Contract Documents and governing codes.
 3. Check the hood for capture and containment of smoke using a smoke emitting device. Observe the smoke pattern. Make adjustments to room airflow patterns to achieve optimum results.
 4. Verify flow at supply plenum if present.
- C. Visually inspect the hood exhaust duct throughout its entire length in compliance with authorities having jurisdiction. Begin at the hood connection and end at the point it discharges outdoors. Report findings.
1. Check duct slopes as required.
 2. Verify that duct access is installed as required.
 3. Verify that point of termination is as required.
 4. Verify that duct air velocity is within the range required.
 5. Verify that duct is within a fire-rated enclosure or is fire wrapped.
- D. Perform sufficient testing to confirm hood's variable speed vs. heat response sequence of operations from manufacturer programming.
- E. Report deficiencies.
- 3.18 PROCEDURES FOR TEMPERATURE MEASUREMENTS
- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
 - B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.
 - C. Measure outside-air, wet- and dry-bulb temperatures.
- 3.19 PROCEDURES FOR VIBRATION MEASUREMENTS
- A. Use a vibration meter meeting the following criteria:
 1. Solid-state circuitry with a piezoelectric accelerometer.
 2. Velocity range of 0.1 to 10 inches per second.
 3. Displacement range of 1 to 100 mils.
 4. Frequency range of at least 0 to 1000 Hz.
 5. Capable of filtering unwanted frequencies.
 - B. Calibrate the vibration meter before each day of testing.
 1. Use a calibrator provided with the vibration meter.
 2. Follow vibration meter and calibrator manufacturer's calibration procedures.

- C. Perform vibration measurements when other building and outdoor vibration sources are at a minimum level and will not influence measurements of equipment being tested.
 - 1. Turn off equipment in the building that might interfere with testing.
 - 2. Clear the space of people.
- D. Perform vibration measurements after air and water balancing and equipment testing is complete.
- E. Clean equipment surfaces in contact with the vibration transducer.
- F. Position the vibration transducer according to manufacturer's written instructions and to avoid interference with the operation of the equipment being tested.
- G. Measure and record vibration on rotating equipment over 3 hp.
- H. Measure and record equipment vibration, bearing vibration, equipment base vibration, and building structure vibration. Record velocity and displacement readings in the horizontal, vertical, and axial planes.
 - 1. Fans and HVAC Equipment with Fans:
 - a. Fan Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Casing: Top and side.
 - d. Equipment Base: Top and side.
 - e. Building: Floor.
 - f. Ductwork: To and from equipment after flexible connections.
 - g. Piping: To and from equipment after flexible connections.
 - 2. HVAC Equipment with Compressors:
 - a. Compressor Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Casing: Top and side.
 - d. Equipment Base: Top and side.
 - e. Building: Floor.
 - f. Piping: To and from equipment after flexible connections.
 - 3. Walk in Cooler Compressors
 - a. Compressor Bearing: Drive end and opposite end.
 - b. Motor Bearing: Drive end and opposite end.
 - c. Equipment Casing: Top and side.
 - d. Equipment Base: Top and side.
 - e. Building: Floor.
 - f. Piping: To and from equipment after flexible connections.
- I. For equipment with vibration isolation, take floor measurements with the vibration isolation blocked solid to the floor and with the vibration isolation floating. Calculate and report the differences.

J. Inspect, measure, and record vibration isolation.

1. Verify that vibration isolation is installed in the required locations.
2. Verify that installation is level and plumb.
3. Verify that isolators are properly anchored.
4. For spring isolators, measure the compressed spring height, the spring OD, and the travel-to-solid distance.
5. Measure the operating clearance between each inertia base and the floor or concrete base below. Verify that there is unobstructed clearance between the bottom of the inertia base and the floor.

K. Compare results to allowable RMS values listed in Drawings and in 230548.

3.20 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check free travel and proper operation of control devices such as damper and valve operators.
- F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.
- G. Check the interaction of electrically operated switch transducers.
- H. Check the interaction of interlock and lockout systems.
- I. Check main control supply-air pressure and observe compressor and dryer operations.
- J. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or non-grounded power supply.
- K. Note operation of electric actuators using spring return for proper fail-safe operations.
- L. Upon completion of the Building Control System completely check out and field test hardware and software to assure that the complete system performs in accordance with the approved sequences of operation. Test all equipment and control functions for proper automatic and manual activation. Test each system and zone for proper operation through its complete heating and cooling cycles.
- M. Include the specific tests and control functions listed below:

1. Full point check.
2. Operation of smoke control strategy.
3. Manual activation of each fan and smoke and fire/smoke damper.
4. System priorities and overrides.
5. Trouble, monitoring and annunciation capability.
6. Power resumption response.
7. System failure response, including emergency power operation.
8. All user notification messages.
9. All controls loops shall be verified as operating in a stable manner with no hunting prior to the start of the commissioning process.

3.21 PROCEDURES FOR INDOOR-AIR QUALITY MEASUREMENTS

- A. After air balancing is complete and with HVAC systems operating at indicated conditions, perform indoor-air quality testing.
- B. Observe and record the following conditions for each main AHU and supply fan HVAC system: Also measure outdoor conditions for point of reference.
 1. The distance between the outside-air intake and the closest exhaust fan discharge, flue termination, or vent termination.
 2. Specified filters are installed. Check for leakage around filters.
 3. Cooling coil drain pans have a positive slope to drain.
 4. Cooling coil condensate drain trap maintains an air seal.
 5. Evidence of water damage.
 6. Insulation in contact with the supply, return, and outside air is dry and clean.
- C. Measure and record indoor conditions served by each HVAC system. Make measurements at multiple locations served by the system if required to satisfy the following:
 1. One location for every 5000 sq. ft, spaced on the floor to address each “island” of floor plate.
- D. Measure and record the following indoor conditions for each location two times at two-hour intervals, and in accordance with ASHRAE 113 and the test methods necessary in order to meet the CHPS for Indoor Air Quality Assessment Credit. Measure outdoor conditions in a single test for point of reference.
 1. Temperature.
 2. Relative humidity.
 3. Air velocity.
 4. Concentration of carbon dioxide (ppm).
 5. Concentration of carbon monoxide (ppm).
 6. Nitrogen oxides (ppm).
 7. Formaldehyde (ppm).
 8. Concentration of PM10 and PM2.5 particulates.
 9. Concentration of Ozone.
 10. Concentration of TVOC's.

11. Concentration of chemicals listed in CDPH Standard Method v1.1, Table 4-1 except Formaldehyde.

3.22 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.
- B. Status Reports: As Work progresses, prepare reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.23 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
 1. Include a list of instruments used for procedures, along with proof of calibration.
- C. Final Report Contents: In addition to certified field report data, include the following:
 1. Fan curves.
 2. Pump curves.
 3. Manufacturers' test data.
 4. Field test reports prepared by system and equipment installers.
 5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.
- D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:
 1. Title page.
 2. Name and address of TAB firm.
 3. Project name.
 4. Project location.
 5. Architect's name and address.
 6. Engineer's name and address.
 7. Contractor's name and address.
 8. Mechanical Subcontractor's name and address.
 9. Report date.
 10. Signature of TAB firm who certifies the report.

11. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.
 12. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 - d. Instrument list (of actual equipment used):
 - 1) Instrument.
 - 2) Manufacturer.
 - 3) Model Number.
 - 4) Serial number.
 - 5) Range and accuracy.
 - 6) Calibration date.
 - 7) Copy of Calibration certificate if factory calibrated.
 - 8) Dates of Use.
 13. Nomenclature sheets for each item of equipment.
 14. Data for terminal units, including manufacturer, type size, and fittings.
 15. Notes to explain why certain items of final data in the body of reports vary from indicated contract values.
 16. Test conditions for fans performance forms including the following:
 - a. Settings for outside-, return-, and exhaust-air dampers.
 - b. Conditions of filters.
 - c. Cooling coil, wet- and dry-bulb conditions.
 - d. Outside air conditions, temperature, relative humidity, CO₂ levels.
 - e. Fan drive settings.
 - f. VFD settings for variable-air-volume systems.
 - g. Settings for supply-air, static-pressure controller.
 - h. Other system operating conditions that affect performance.
- E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outside, supply, return, and exhaust airflows.
 2. Water flow rates.
 3. Duct, outlet, and inlet sizes.
 4. Pipe and valve sizes and locations.
 5. Terminal units.
 6. Balancing stations.
 7. Position of balancing devices.
- F. RTU Test Reports: (tests shall be run with clean filters and a simulated 50% dirty condition achieved by physically blocking 50% of flow at the cool or filter face) For air-handling units with coils, include the following:

1. Unit Data: Include the following:
 - a. Unit identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Unit arrangement and class.
 - g. Discharge arrangement.
 - h. Sheave make, size in inches, and bore.
 - i. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - j. Number of belts, make, and size.
 - k. Number of filters, type, and size.
2. Motor Data:
 - a. Manufacturer
 - b. Make and frame type and size.
 - c. Horsepower
 - d. Rpm.
 - e. Volts, phase, and hertz, including nameplate, actual and no load.
 - f. Full-load amperage and service factor.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - i. Starter type.
 - j. Starter size, rating, heater elements if not a VFD.
3. Belt Drive (if applicable):
 - a. Identification.
 - b. Location.
 - c. Required driven sheave RPM.
 - d. Driven sheave, diameter.
 - e. Motor sheave diameter.
 - f. Motor sheave RPM.
 - g. Belt size and quantity.
 - h. Belt manufacturer and model number.
 - i. Center to center distance, maximum, minimum and actual.
4. Test Data (Indicated and Actual Values):
 - a. Supply air flow, in cfm.
 - b. Return air flow, in cfm.
 - c. Outside air flow, in cfm.
 - d. Exhaust air flow, in cfm.
 - e. Supply fan Total system static pressure in inches wg.
 - f. Supply Fan rpm.
 - g. Supply Fan Discharge static pressure in inches wg.
 - h. Return fan Total system static pressure in inches wg.
 - i. Return Fan rpm.
 - j. Return Fan Suction static pressure in inches wg (Pa).

- k. Suction pressure at outside air connection to unit, in inches wg (Pa).
- l. Mixing box suction pressure for outside air inlet and return mixing in inches wg (Pa).
- m. Discharge pressure on Exhaust in inches wg (Pa).
- n. Filter static-pressure differential in inches wg (Pa). (clean conditions, 50% blockage simulating dirty condition)
- o. Cooling coil static-pressure differential in inches wg.
- p. Other component static-pressure differentials in inches wg.
- q. Outside airflow in cfm.
- r. Return airflow in cfm.
- s. Outside-air damper position.
- t. Return-air damper position.
- u. Return air temperature.
- v. Outside air temperature.
- w. Mixed air temperature.
- x. Outside/ return air ratio.
- y. Diagram shall be provided that maps the flows and pressures onto a schematic of the system.

G. Apparatus-Coil Test Reports:

1. Coil Data:

- a. System identification.
- b. Location.
- c. Service.
- d. Manufacturer.
- e. Coil type.
- f. Number of rows.
- g. Fin spacing in fins per inch (mm) o.c.
- h. Make and model number.
- i. Face area in sq. ft. (sq. m).
- j. Tube size in NPS (DN).
- k. Tube and fin materials.
- l. Circuiting arrangement.

2. Test Data (Indicated and Actual Values), cooling coils shall be tested at air full flow, full capacity, heating coils shall be tested at heating flow and full heating capacity but shall have an extra air-side pressure drop measurement recorded during full cooling flow condition:

- a. Airflow rate in cfm.
- b. Average face velocity in fpm.
- c. Air pressure drop in inches wg.
- d. Outside-air, wet- and dry-bulb temperatures in deg F.
- e. Return-air, wet- and dry-bulb temperatures in deg F.
- f. Entering-air, wet- and dry-bulb temperatures in deg F.
- g. Leaving-air, wet- and dry-bulb temperatures in deg F.
- h. Water flow rate in gpm.
- i. Water pressure differential in feet of head or psig.

- j. Entering-water temperature in deg F.
 - k. Leaving-water temperature in deg F.
 - l. Refrigerant expansion valve and refrigerant types, as applicable
 - m. Refrigerant suction pressure in psig
 - n. Refrigerant suction temperature in deg F
- H. Fan Test Reports: For supply, return, and exhaust fans, include the following:
- 1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Manufacturer, Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - 2. Motor Data:
 - a. Make and frame type and size.
 - b. Manufacturer
 - c. Horsepower and rpm.
 - d. Volts, phase, and hertz.
 - e. Full-load amperage and service factor.
 - f. Sheave make, size in inches, and bore.
 - g. Sheave dimensions, center-to-center, and amount of adjustments in inches.
 - h. Number of belts, make, and size.
 - i. Starter type.
 - j. Starter size, rating, heater elements if not a VFD.
 - 3. Test Data (Indicated and Actual Values):
 - a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.
- I. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
- 1. Report Data:
 - a. System and air-handling unit number.
 - b. Location and zone.
 - c. Traverse air temperature in deg F.
 - d. Duct static pressure in inches wg.
 - e. Duct size in inches.
 - f. Duct area in sq. ft..

- g. Indicated airflow rate in cfm.
 - h. Indicated velocity in fpm.
 - i. Actual airflow rate in cfm.
 - j. Actual average velocity in fpm.
 - k. Barometric pressure in psig.
 - l. Air correction factor.
- J. Terminal Unit Data (For reheat coil performance refer to Apparatus Coil Test reports above):
 - 1. Report Data:
 - a. Manufacturer
 - b. Type (constant, variable, single, dual duct).
 - c. Identification/number.
 - d. Location.
 - e. Model number.
 - f. Size.
 - g. Minimum inlet static pressure by manufacturer.
 - h. Actual inlet static pressure.
 - i. Minimum design air flow.
 - j. Maximum design air flow.
 - k. Maximum actual air flow.
 - l. Minimum actual airflow.
 - m. Actual pressure differential between inlet and outlet at maximum flow.
- K. Air Inlet/Outlet / Diffuser Reports:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone, room number.
 - c. Test apparatus used.
 - d. Area served.
 - e. Air-terminal-device make.
 - f. Air-terminal-device number from system diagram.
 - g. Air-terminal-device type and model number.
 - h. Air-terminal-device size.
 - i. Air-terminal-device effective area in sq. ft..
 - j. Air-terminal-device area or k factor.
 - 2. Test Data (Indicated and Actual Values):
 - a. Airflow rate in cfm.
 - b. Air velocity in fpm.
 - c. Preliminary airflow rate as needed in cfm.
 - d. Preliminary velocity as needed in fpm.
 - e. Final airflow rate in cfm.
 - f. Final velocity in fpm.
 - g. Space temperature in deg F.
 - h. Percent of design air flow.

- i. Air velocity at 6 feet above finished floor at center of centerline of throw of devices closest to the wall measured within 1 foot of each wall.
 - j. Air velocity at 6 feet above finished floor at center of room.
- L. System-Coil Reports: For reheat coils terminal units, and devices containing a fan and coil such as fan coil units. Refer to the Fan Data portion of this specification for recording and measurement requirement associated with fan performance. For the coils, include the following:
 - 1. Unit Data:
 - a. System and air-handling unit identification.
 - b. Location and zone.
 - c. Room or riser served.
 - d. Coil make and size.
 - e. Flowmeter type.
 - 2. Test Data (Indicated and Actual Values):
 - f. Airflow rate in cfm.
 - g. Air static-pressure differential in inches wg.
 - h. Total air pressure across fan in inches wg.
 - i. External pressure developed by fan in inches wg.
 - j. Water flow rate in gpm.
 - k. Entering-water temperature in deg F.
 - l. Leaving-water temperature in deg F.
 - m. Water pressure drop in feet of head or psig.
 - n. Entering-air temperature in deg F.
 - o. Leaving-air temperature in deg F.
- M. Boiler Test Reports:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Manufacturer, Make and type.
 - e. Model and serial numbers.
 - f. Fuel type and input in Btuh (kW).
 - g. Number of passes.
 - h. Ignition type.
 - i. Burner-control types.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - l. Firing rate.
 - m. Overfire draft.
 - n. Gas meter timing dial size.
 - o. Gas meter time per revolution.
 - p. Gas pressure at meter outlet.
 - q. Gas flow rate.

- r. Heat input.
 - s. Burner manifold gas pressure.
- 2. Test Data (Indicated and Actual Values):
 - a. Operating pressure in psig.
 - b. Operating temperature in °F.
 - c. Entering-water temperature in °F.
 - d. Leaving-water temperature in °F.
 - e. Number of safety valves and sizes in NPS.
 - f. Safety valve settings in psig.
 - g. High-limit setting in psig.
 - h. Operating-control setting.
 - i. High-fire set point.
 - j. Low-fire set point.
 - k. Voltage at each connection.
 - l. Amperage for each phase.
 - m. Draft fan voltage at each connection.
 - n. Draft fan amperage for each phase.
 - o. Manifold pressure in psig.
 - p. Heat output.
 - q. Flue gas temperature at outlet.
 - r. Ambient temperature.
 - s. Net stack temperature.
 - t. Percent stack loss.
 - u. Percent combustion efficiency.
- N. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
 - 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Manufacturer, Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor rated horsepower, brake horsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):

- a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - l. Brake horsepower.
 - m. RPM.
- O. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:
- 1. Unit Data:
 - a. Unit identification.
 - b. Location.
 - c. Service.
 - d. Manufacturer, Make and size.
 - e. Model and serial numbers.
 - f. Water flow rate in gpm.
 - g. Water pressure differential in feet of head or psig.
 - h. Required net positive suction head in feet of head or psig.
 - i. Pump rpm.
 - j. Impeller diameter in inches.
 - k. Motor make and frame size.
 - l. Motor rated horsepower, brakehorsepower and rpm.
 - m. Voltage at each connection.
 - n. Amperage for each phase.
 - o. Full-load amperage and service factor.
 - p. Seal type.
 - 2. Test Data (Indicated and Actual Values):
 - a. Static head in feet of head or psig.
 - b. Pump shutoff pressure in feet of head or psig.
 - c. Actual impeller size in inches.
 - d. Full-open flow rate in gpm.
 - e. Full-open pressure in feet of head or psig.
 - f. Final discharge pressure in feet of head or psig.
 - g. Final suction pressure in feet of head or psig.
 - h. Final total pressure in feet of head or psig.
 - i. Final water flow rate in gpm.
 - j. Voltage at each connection.
 - k. Amperage for each phase.
 - l. Brake horsepower.

m. RPM.

P. Vibration Measurement Reports: For each rotating piece of equipment required by previous procedures in this section, provide.

1. Date and time of test.
2. Vibration meter manufacturer, model number, and serial number.
3. For each item of equipment:
 - a. Equipment designation.
 - b. Location.
 - c. Equipment type.
 - d. Equipment speed and motor speed.
 - e. Motor horsepower.
 - f. Diagram of equipment showing the vibration measurement locations.
 - 1) Location of points for fans:
 - a) Fan bearing, drive end.
 - b) Fan bearing, opposite end.
 - c) Motor bearing, center (when applicable).
 - d) Motor bearing, drive end.
 - e) Motor bearing, opposite end.
 - f) Casing (bottom or top).
 - g) Casing (side).
 - h) Duct after flexible connection (discharge).
 - i) Duct after flexible connection (suction).
 - 2) Location of points for compressors:
 - a) Equipment casing (top).
 - b) Equipment casing (side).
 - c) Pipes after flexible connection (discharge) for all connections.
 - d) Pipes after flexible connection (suction) for all connections.
 - 3) Test readings:
 - a) Horizontal, velocity and displacement.
 - b) Vertical, velocity and displacement.
 - c) Axial, velocity and displacement.
 - g. Measurement readings for each measurement location.
 - h. Calculate isolator efficiency using measurements taken.
 - i. Description of predominant vibration source.
 - j. Normally acceptable readings, velocity and acceleration per 230548.
 - k. Unusual conditions at time of test.

Q. Sound Measurement Reports: Record sound measurements on octave band and dBA test forms and on an NC or RC chart indicating the decibel level measured in each frequency band for both "background" and "HVAC system operating" readings. Record each

designated tested location per the procedures description mentioned previously in this section on a separate NC or RC chart. Record the following on the forms:

1. Date and time of test. Record each tested location on its own NC curve.
2. Sound meter manufacturer, model number, and serial number.
3. Space location within the building including floor level and room number. Rooms required to have sound testing
4. Diagram or color photograph of the space showing the measurement location.
5. Time weighting of measurements, either fast or slow.
6. Description of the measured sound: steady, transient, or tonal.
7. Description of predominant sound source.
8. RC level with equipment on versus required RC for the room per the Drawings (where none is explicitly stated, refer to ASHRAE Handbook "HVAC Applications").

R. Indoor--Air Quality Measurement Reports for Each HVAC System:

1. HVAC system designation.
2. Date and time of test.
3. Outdoor temperature, relative humidity, wind speed, and wind direction at start of test.
4. Room number or similar description for each location.
5. Measurements at each location.
6. Observed deficiencies.

S. Room Pressurization Tests (for pressure-critical enclosed rooms): Locker rooms, toilet rooms, kitchen/food preparation rooms, trash areas, Loading dock areas, copier rooms.

1. Room location and number.
2. Total room supply, specified and actual.
3. Total room return/exhaust summed, specified and actual.
4. Calculated differential cfm, specified and actual.
5. Differential pressure across closed door.
6. Differential pressure across open door.

T. Miscellaneous Equipment Reports:

1. Include Fan coils, general exhaust fans, etc.
2. All air, water, fan, motor and controller data specified above.
3. Grease hood variable speed and heat response operation per manufacturer sequences of operations.

U. Duct Leak Test: (see 233100 for procedures)

1. Description of ductwork under test (include highlighted drawing).
2. Duct design operating pressure.
3. Duct design test static pressure.
4. Duct capacity, air flow.
5. Maximum allowable duct surface area.
6. Allowable leak factor.

7. Allowable leakage (cfm).
8. Test apparatus:
 - a. Blower.
 - b. Orifice, tube size.
 - c. Orifice size.
 - d. Calibrated.
9. Test static pressure.
10. Test orifice differential pressure.
11. Leakage flow (from orifice chart).
12. Include copy of test device orifice calibration chart.
13. Calculation description to determine allowable.

V. Airflow Monitoring Station Data:

1. Identification/location.
2. System.
3. Size.
4. Area.
5. Design velocity.
6. Design air flow.
7. Test velocity.
8. Test air flow.
9. Reading at electronic interface/ sensor.

W. Flow Measuring Station:

1. Identification/number.
2. Location.
3. Size.
4. Manufacturer.
5. Model number.
6. Serial number.
7. Design Flow rate.
8. Design pressure drop.
9. Actual/final pressure drop.
10. Actual/final flow rate.
11. Reading on the electronic interface/ sensor.
12. Station calibrated setting.

X. VAV system pressure controller calibration:

1. System.
2. Identification/number.
3. Location.
4. Device Manufacturer.
5. Model number.
6. Serial number.

7. Actual/final static pressure.
8. Actual/final flow rate measured at that location.
9. Reading on the electronic interface/ sensor.
10. Confirmation of setpoint in building management system.

Y. Variable Flow Hydronic system pressure controller calibration:

1. System.
2. Identification/number.
3. Location.
4. Device Manufacturer.
5. Model number.
6. Serial number.
7. Actual/final static pressure.
8. Actual/final flow rate measured at that location.
9. Reading on the electronic interface/ sensor.
10. Confirmation of setpoint in building management system.

3.24 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, and a 72-hour test has been successfully completed, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report. Advise the Owner 7 days in advance of check tests.
2. Randomly check the following for each system (this is in addition to the onsite Random Check requirements that are witnessed by the Owner).
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure water flow of at least 5 percent of terminals.
 - c. Measure room temperature at each thermostat/temperature and CO2 sensor for at least 5 percent of devices. Compare the reading to the set point.
 - d. Measure sound levels at two locations.
 - e. Measure space pressure of at least 10 percent of locations.
 - f. Verify that balancing devices are marked with final balance position.
 - g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by the Owner.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Owner.
3. Owner shall randomly select measurements documented in the final report to be rechecked. The rechecking shall be limited to the items noted under Onsite Random Checks and/or the extent of measurements that can be accomplished in a normal 8-hour business day.

4. If the rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.25 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700 - HVAC INSULATION

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. Contractor to provide insulation for all equipment, piping and ductwork.
- B. Provide materials and accessories for installation of HVAC insulation as indicated on the drawings and as specified herein.

1.3 RELATED SECTIONS:

- A. Section 230529 "Hangers and Supports for HVAC."
- B. Section 230553 "Identification for HVAC."
- C. Section 233113 "Metal Ducts"

1.4 REFERENCES

- A. American Society for Testing and Materials
 - 1. ASTM C107 -
 - 2. ASTM C177 – Steady-State Heat Flux Measurements and Thermal Transmission Properties by Mean of Guarded-Hot-Plate Apparatus.
 - 3. ASTM C195 – Standard Specification for Mineral Fiber Thermal Insulation Cement.
 - 4. ASTM C335 – Steady-State Heat Transfer Properties of Horizontal Pipe Insulation
 - 5. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic Setting Thermal Insulating and Finishing Cement.
 - 6. ASTM C518 – Steady-State Heat Flux Measurement and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
 - 7. ASTM C533 – Standard Specification for Calcium Silicone Block and Pipe Thermal Insulation
 - 8. ASTM C534 – Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.
 - 9. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation
 - 10. ASTM C552 – Standard Specification for Cellular Glass Thermal Insulation.
 - 11. ASTM C553 – Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.
 - 12. ASTM C585 – Inner and Outer Diameters of Rigid Thermal Insulation for Nominal Sizes of Pipe
 - 13. ASTM C591 – Standard Specification for Unfaced Preformed Rigid Cellular Polyisocyanurate Thermal Insulation
 - 14. ASTM C592 – Standard Specification for Mineral Fiber Blanket Insulation and Blanket Type Pipe Insulation (Metal -Mesh Covered) (Industrial Type).
 - 15. ASTM C612 – Standard Specification for Mineral Fiber Block and Board Thermal Insulation
 - 16. ASTM C795 – Standard Specification for Thermal Insulating for Use in Contact with Austenitic Stainless Steel.

17. ASTM C921 – Properties of Jacketing Materials for Thermal Insulation
18. ASTM C1071 – Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material.)
19. ASTM C1104 – Standard Test Method for Determining the Water Vapor Sorption of Unfaced Mineral Fiber Insulation
20. ASTM C1126 – Standard Specification for Faced or Unfaced Rigid Cellular Phenolic Thermal Insulation
21. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation
22. ASTM C1290 – Standard Specification for Flexible fibrous Glass Blanket Insulation Used for Externally Insulate HVAC Ducts.
23. ASTM E84 – Surface Burning Characteristics of Building Materials.
24. ASTM E96 – Water Vapor Transmission of Materials.

B. American Society of Heating, Refrigeration, and Air Conditioning (ASHRAE)

1. Advanced Energy Design Guide for K-12 School Building

C. National Fire Protection Association

1. NFPA 96 – Standard for Ventilation Control and Fire Protection of Commercial Cooling Operation.
2. NFPA 255 – Surface Burning Characteristics of Building Materials

D. Underwriters Laboratories Inc

1. UL 181 -
2. UL 723 – Surface Burning Characteristics of Building Material
3. UL 1978 – Grease Duct
4. UL 2221 – Standard for Tests of Fire Resistive Grease Duct Enclosure

E. SMACNA

1. SMACNA – HVAC Duct Construction Standards – Metal and Flexible

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any) for each service and location. Provide copy of laboratory fire test data for fire barrier duct wrap. Provide VOC data.
- B. Material Test Report: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include states of tests and test method employed.
- C. 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 insulation application at pipe expansion joints for each type of insulation
 4. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
 5. Detail removable insulation at pipe specialties, equipment connections, and access panels.
 6. Detail application of field applied jacket

7. Detail application at linkages of control devices
8. Detail field application for each equipment type

D. Qualification Data

1. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years' experience.
2. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

E. Field quality control report.

F. Project Record Documents: Identify locations of all insulation types.

G. Operation and Maintenance Data: Submit manufacturer's instruction on sealing and resealing of insulation.

H. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical product per ASTM E84, by a testing and inspecting 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 and inspecting 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.
3. Flame proofing treatment subject to deterioration due to moisture or humidity is not acceptable.

B. HVAC insulation will be manufactured and tested in factory under implemented Quality Management Systems which are certified to be in accordance with ISO 9001 quality standard.

C. Ductwork and piping insulation to conform to ASHRAE 90A and NFPA 90. Supply air ducts to have vapor barrier with joints butted for a vapor type system. Return air ducts to have joints and seams lapped. All duct insulation secured in place with galvanized steel wire. Insulation exposed to weather shall be encased in 0.016 inch embossed aluminum jacket, Childers or equal.

D. Except where acoustic lining is shown on the drawings, provide external insulation on ductwork. To avoid particulate accumulation and mold in the ductwork, duct liners must meet the American Society for Testing and Materials (ASTM) standards C1071 of UL 181 for surface erosion resistance and ASTM standards C1104 or C209 (at <0.5% absorption by volume) for water vapor sorption.

E. The contractor shall research the current flame spread and smoke developed test ratings to ensure compliance with the Mechanical Code.

F. For duct lagging refer to section 230548.

G. Mockups: Before installing insulation, build mockups for each type of insulation and finish listed below to demonstrate quality of insulation application and finishes. Build mockups in the

location indicate, or if not indicated, as directed by Owner's Representative. Use materials indicated for the complete work.

1. Ductwork Mocks

- a. One 10-foot section each rectangular and round straight duct.
- b. One each of a 90-degree mitered round and rectangular elbow, and one each of a 90-degree radius round and rectangular elbow.
- c. One rectangular branch takeoff and one round branch takeoff from a rectangular duct. One round tee fitting.
- d. One rectangular and round transition fitting.
- e. Four support hangers for round and rectangular ductwork
- f. Each type of damper and specialty.

2. Piping Mockups

- a. One 10-foot section of NPS 2 straight pipe.
- b. One each of 90-degree threaded, welded, and flanged elbow.
- c. One each of a threaded, welded, and flanged tee fitting.
- d. One NPS2 or smaller valve, and one NPS 2-1/2 or larger valve.
- e. Four support hangers including hanger shield and insert.
- f. One threaded strainer and one flanged strainer with removable portion of insulation.
- g. One threaded reducer and one welded reducer.
- h. One pressure temperature tap.
- i. One mechanical coupling.

3. Mechanical Mockups

- a. One chilled-water pump and one heating-hot-water pump.
- b. One tank or vessel

- 4. For each mockup, fabricate cutaway sections to allow observation of application details for insulation material, adhesives, mastics, attachments, and jackets.
- 5. Notify owner's representative seven days in advance of dates and times when mockups will be constructed.
- 6. Obtain owner's representative's approval of mockups before starting insulation application.
- 7. Approval of mockups does not constitute approval of deviations from the contract documents contained in mockups unless owner's representative specifically approves such deviations in writing.
- 8. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed work.
- 9. Demolish and remove mockups when directed.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.
- B. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.
- C. Protect insulation from weather and construction traffic, dirt, water, chemical, and damage, by storing in original wrapping on pallets and then covered with sheet plastic.

- D. The contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation materials shall be installed that has become damaged in any way. The contractor shall also use all means necessary to protect work and materials installed by other trades.
- E. If any insulation material has become wet because of transit or job site exposure to moisture or water, the contractor shall not install such material, and shall remove it from the job site.
- F. Remove waste packaging materials from site and dispose of packaging materials at appropriate recycling facilities.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. Install insulation only when ambient temperature and humidity conditions are within the range recommended by manufacturer
- B. Maintain temperature during and after installation for minimum period as recommended by the manufacturer.
- C. If at any time glass or glass fiber insulation is wetted, it shall be considered damaged material and shall be removed and replaced at no cost to owner.

1.9 COORDINATION

- A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."
- B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.
- C. Coordinate installation and testing of heat tracing.

1.10 SCHEDULING

- A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.
- B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.11 FIELD MEASUREMENT

- A. Verify field measurements prior to installation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Subject to compliance with requirements, provide products by one of the manufacturers specified unless otherwise listed in subparagraph in part 2 articles:
 - 1. CertainTeed Corp
 - 2. Johns Manville, Microlite
 - 3. Knauf Insulation,

4. Mains Insulation
5. Owens Corning
6. Or Equal

2.2 INSULATION MATERIALS

- A. Comply with requirements in Part 3 schedule articles for where insulating and jacket materials shall be applied.
- B. Products shall not contain asbestos, lead, mercury, or mercury compounds.
- C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.
- D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.
- E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.
- F. All products placed under this section shall have certified ASTM E84 ratings as follows:
 1. Insulation Installed Indoors: Flame spread index of 25 or less, and smoke developed index of 50 or less.
 2. Insulation Installed Outdoor: Flame spread index of 75 or less, and smoke developed index of 150 or less.
 3. Flame proofing treatment subject to deterioration due to moisture or humidity is not acceptable.
- G. Calcium Silicate:
 1. Preformed Pipe Section: Flat-, curved-, and grooved-block sections of noncombustible, inorganic, hydrous calcium silicate with non-asbestos fibrous reinforcement Comply with ASTM C533, Type I.
 - a. 1/2-inch to 24 inch
 - b. "K" factor: ASTM C335, 0.389 at 75°F
 - c. Maximum service temperature: 1200°F
 - d. Maximum moisture absorption: 0.2 percent by volume
 - e. Density: 14 lb/cu.ft
 - f. Waterproofed
 - g. Flexural strength: 50 psi
 - h. Compressive strength: 100psi
 - i. Integral corrosion inhibitor
 2. Prefabricated Fittings Covers: Comply with ASTM C450 and ASTM C585 for dimensions used in preforming insulation to cover valves, elbows, tees, and flanges.
 - a. "K" factor ASTM C335, 0.373 at 75°F
 - b. Maximum service temperature 1200°F
 - c. Density: 14 lb/cu.ft
 - d. Waterproofed
 - e. Flexural strength: 50 psi
 - f. Compressive strength: 100psi
 - g. Integral corrosion inhibitor

- H. Flexible Elastomeric: Close-cell, sponge- or expanded-rubber materials. Comply with ASTM C534, Type II for sheet materials
 - 1. Manufacturer:
 - a. Meroflex USA Inc.
 - b. K-Flex USA
 - c. Armstrong Industries
 - 2. Preformed flexible elastomeric cellular thermal insulation in sheet and tubular form, ASTM C534, Type I, Tubular form
 - a. "K" factor: ASTM C177, 0.27 at 75°F
 - b. Maximum service temperature: 220°F
 - c. Minimum service temperature: -20°F
 - d. Maximum moisture absorption: 0.2 percent by volume
- I. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
 - 1. "K" factor: ASTM C177 or ASTM C518, 0.23 at 75°F
 - 2. Maximum service temperature: 450°F
 - 3. Maximum Moisture Absorption: 0.1 percent by volume.
 - 4. Density: 1.5 lb/cu ft
- J. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide semi-rigid insulation with factory applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article. Insulation, ASTM C612 Mineral Fiber Block and Board Insulation, Type IA.
 - 1. "K" factor: ASTM C177 or ASTM C518, 0.23 at 75°F
 - 2. Maximum service temperature: 450°F
 - 3. Maximum Moisture Absorption: 0.1 percent by volume.
 - 4. Density for general applications, except at trapeze supports: 3.0 lb/cu ft
 - 5. Density for insulating bottom support at trapeze hangers: 6.0 lb/cu ft
- K. Mineral-Fiber, Preformed Pipe Insulation
 - 1. Type I, 850°F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C547, Type I, Grade A, with factory applied ASJ or ASJ-SSL. Factory applied jacket requirements are specified in "Factory Applied Jackets" Article.
 - a. "K" factor: ASTM C177, 0.24 at 75°F
 - b. Maximum service temperature: 650°F.
 - c. Maximum moisture absorption: 0.2 percent by volume.
 - 2. Insulation for stainless steel pipe: ASTM C795, semi-rigid, noncombustible, end grain adhered to jacket.
 - a. "K" factor: ASTM C177, 0.24 at 75°F
 - b. Maximum service temperature: 650/248F
 - c. Maximum moisture absorption: 0.2 percent by volume.

- L. Mineral-Fiber, Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semi-rigid board material with factory applied ASJ complying with ASTM C1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C612, Type IB. Nominal density is 2.5 lb/cu ft or more. Thermal conductivity (k-value) at 100°F is 0.29 Btu . in/h . sq.ft. °F or less. Factory applied jacket requirements are specified in "Factory Applied Jackets" Article.

2.3 FIRE-RATED INSULATION SYSTEMS

- A. Fire-Rated Board: Structural -grade, press-molded, xonolite calcium silicate, fireproofing board suitable for operating temperature up to 1700°F. Specified fire rating are achieved by testing in accordance with ASTM, UL test standard. UL listed to provide 2 hours rating fire rated assembly.
 - 1. Density: 28 lb/cu.ft
 - 2. Compressive strength at 10% deformation: 900 psi
 - 3. Flexural strength: 550 psi
 - 4. Linear shrinkage 24 hours at 1800°F: less than 2 percent
 - 5. Maximum continuous service temperature: 1800°F
 - 6. R-Value: 1.7 at 75°F
 - 7. Products: Subject to compliance with requirements, provide one of the following:
 - a. Johns Manville; Firetemp M.
 - b. Thermal Ceramics; FireMaster Duct Wrap.
 - c. 3M; Fire Barrier Wrap Products.
 - d. Or equal
- B. Fire-Rated Blanket: High-temperature, flexible, blanket insulation with FSK jacket that is UL listed to provide a 2 hour fire rating
 - 1. Manufacturers:
 - a. Certain Teed Corp, FlameChek
 - b. Johns Manville: Frietemp Wrap
 - c. Thermal Ceramics: FireMaster Duct Wrap
 - d. 3M Fire Barrier Wrap Product
 - 2. Design Requirements: Provide duct wrap materials and systems which have been manufactured, fabricated, and installed to the following design criteria:
 - a. Material: Patented inorganic blanket encapsulated with a scrim-reinforced foil.
 - b. Type and Size: roll 2 inches x area required.
 - c. Weight: 1.83 lb/cu.ft
 - d. Thermal Conductivity at 500°F (ASTM C411, ASTM C518): 0.417 Btu/sq.ft - h - °K
 - e. Surface Burning Characteristics (ASTM E84): Flame spread index 0, smoke developed index 0.
 - f. Combustibility (ASTM E136): Noncombustible.
 - 3. Provide accessory products and materials as follows:
 - a. Aluminum Foil Tape:
 - 1) Type and Size: Acceptable to wrap material
 - b. Filament Tape:
 - 1) Width: Minimum 3/4 inch

- c. Bending Material and Banding Clip:
 - 1) Material: Carbon steel or stainless steel.
 - 2) Width: Minimum 1/2 inch
 - 3) Thickness: Minimum 0.015 inch
- d. Insulation Pins
 - 1) Material: Copper-coated steel.
 - 2) Size: Minimum 12 gauge
- e. Speed Clips:
 - 1) Material: Galvanized steel.
 - 2) Type and Size: Minimum 1-1/2 inches square or 1-1/2 inches diameter round or equivalent sized insulated cup-head pins.
- f. Access Door Hardware:
 - 1) Type: Threaded rods with 1/4 inch wing nuts and 1/4 inch washers.
 - 2) Material: Galvanized steel
 - 3) Diameter: 1/4 inch
 - 4) Length: 4-1/2 inches – 5 inches
- g. Access Door Hardware:
 - 1) Type: Hollow tubing to fit threaded rods
 - 2) Material: Steel
 - 3) Length: 4 inches
- h. Fire Barrier Silicone Sealant: Per manufacturer.

C. Penetrations through rated walls:

- 1. Provide commercial pipe sleeve assemblies, which are UL listed for this purpose, at every penetration of rated walls as required by authority having jurisdiction.

2.4 FACTORY APPLIED JACKETS

A. Insulation system schedules indicate factory applied jackets on various applications. When factory applied jackets are indicated, comply with the following:

- 1. FSK Jacket: Aluminum-foil, fiberglass reinforced scrim with Kraft paper backing, complying with ASTM C1136, Type II.
- 2. FSK Jacket: White polypropylene scrim Kraft backing, complying with ASTM C1136, Type II.

2.5 FIELD APPLIED JACKETS

- A. Field applied jackets shall comply with ASTM C921, Type I, unless otherwise indicated.
- B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D1784, Class 16354-C, thickness as scheduled. Roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
 - 1. Minimum service temperature: -40°F
 - 2. Maximum service temperature: 150°F

3. Moisture vapor transmission: ASTM E96, 0.002 perm-inches
4. Maximum flame spread: ASTM E84, 25
5. Maximum smoke developed: ASTM E84,, 50
6. Connections: Brush on welding adhesive, tacks or pressure sensitive color matching vinyl tape.
7. Adhesive: as recommended by jacket material manufacturer
8. Color: white
9. Factory-fabricated fitting covers to match jacket if available, otherwise field fabricated
 - a. Shapes: 45- and 90- degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, traps, and mechanical joints, and P-trap.
10. Factory fabricated tank heads and tank side panels.

C. Aluminum jacket

1. Comply with ASTM B209
2. Factory cut and rolled to size
3. Smooth finish sheet with thickness required for welding (0.016 inch thick minimum)
4. Moisture barrier for indoor applications: 1-mil thick, heat-bonded polyethylene and Kraft paper.
5. Moisture barrier for outdoor application: 3-mil thick, heat-bonded polyethylene and Kraft paper
6. Factory fabricated fitting covers
 - a. Same material, finish, and thickness as jacket.
 - b. Preformed 2-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.
 - i. Joining: longitudinal slip joints and 2 inches laps
 - j. Metal jacket bands: 3/8-inch wide, 0.015 inch thick stainless steel.

2.6 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. All adhesive shall have a VOC content of 50g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24) and shall comply with CalGreen requirements with regard to being low VOC products.
- C. Adhesive shall comply with the testing and product requirements of California Department of Health Services 'Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.'
- D. Adhesives, Sealants, Coatings will be provided by
 1. Foster Products
 2. Childers Product
 3. Or equal

- E. Calcium Silicate Adhesive: fibrous, sodium-silicate-based adhesive with a service temperature range of 50 to 800 deg. F
- F. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
- G. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
- H. ASJ Adhesive and FSK Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
- I. PVC Jacket Adhesive: Compatible with PVC jacket.
- J. Products: Subject to compliance with requirements, provide one of the following:

2.7 MASTICS

- A. Vapor Barrier Materials shall be compatible with insulation materials, jackets, and substrates, comply with MIL-C-19565C, Type II and must be QPL listed.
 - 1. For indoor applications, use mastics that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- B. Vapor-Barrier Mastic: Water based; suitable for indoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Product, H B Fuller Construction Products: CP-38, (VOC 33g/L) QPL listed.
 - b. Foster Product, H B Fuller Construction Products, 30-80 (VOC 33g/L) QPL listed
 - c. Marathon Industries, Inc. 590
 - 2. Water Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-Mil dry film thickness.
 - 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 - 4. Solids Content: ASTM D 1644, 58 percent by volume and 70 percent by weight.
 - 5. Color: White.
- C. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; Encacel.
 - b. Eagle Bridges - Marathon Industries; 570.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 60-95/60-96.
 - 2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
 - 3. Service Temperature Range: Minus 50 to plus 220 deg F.
 - 4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.
 - 5. Color: White.
- D. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
 - 1. Products: Subject to compliance with requirements, provide one of the following:

- a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
 - b. Eagle Bridges - Marathon Industries; 550.
 - c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
 - d. Mon-Eco Industries, Inc.; 55-50.
 - e. Vimasco Corporation; WC-1/WC-5.
2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
 3. Service Temperature Range: Minus 20 to plus 180 deg F.
 4. Solids Content: 60 percent by volume and 66 percent by weight.
 5. Color: White.

2.8 LAGGING ADHESIVES

- A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
- B. For indoor applications, use lagging adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
 - b. Vimasco Corporation; 713 and 714.
 - c. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct insulation.
 2. Service Temperature Range: 0 to plus 180 deg F.
 3. Color: White.

2.9 SEALANTS

- A. FSK and Metal Jacket Flashing Sealants:
- B. Products: Subject to compliance with requirements, provide one of the following:
 1. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.Eagle Bridges - Marathon Industries; 405.
 2. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 95-44.
 3. Mon-Eco Industries, Inc.; 44-05.
- C. Materials shall be compatible with insulation materials, jackets, and substrates.
- D. Fire- and water-resistant, flexible, elastomeric sealant.
- E. Service Temperature Range: Minus 40 to plus 250 deg F.
- F. Color: Aluminum.
- G. 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).

- H. 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."

2.10 TAPES

- A. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 491 AWF FSK.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
 - c. Compac Corporation; 110 and 111.
 - d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.
- 2. Width: 3 inches.
- 3. Thickness: 6.5 mils.
- 4. Adhesion: 90 ounces force/inch in width.
- 5. Elongation: 2 percent.
- 6. Tensile Strength: 40 lbf/inch in width.
- 7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

- B. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

- 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. ABI, Ideal Tape Division; 488 AWF.
 - b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
 - c. Compac Corporation; 120.
 - d. Venture Tape; 3520 CW.
- 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.

- C. PVC Tape: White vapor-retarder tape matching filed applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications

- 1. Manufacturer:
 - a. Avery Dennison Corporation
 - b. Compac Corp
- 2. Width: 2 inches
- 3. Thickness: 6 mils
- 4. Adhesion: 64 ounces force/inch in width
- 5. Elongation: 500 percent
- 6. Tensile strength: 18 lbf/inch in width

2.11 SECUREMENTS

- A. Bands:

- 1. Products: Subject to compliance with requirements, provide one of the following:

- a. ITW Insulation Systems; Gerrard Strapping and Seals.
 - b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.
 - c. Equal.
 2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal or closed seal.
 3. 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. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; CHP-1.
 - b. GEMCO; Cupped Head Weld Pin.
 - c. Midwest Fasteners, Inc.; Cupped Head.
 - d. Nelson Stud Welding; CHP.
- C. 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. Comply with the following requirements:
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; Tactoo Perforated Base Insul-Hangers.
 - b. GEMCO; Perforated Base.
 - c. Midwest Fasteners, Inc.; Spindle.
 2. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
 3. Spindle: Copper- or zinc-coated, low-carbon steel or stainless steel, fully annealed, 0.106-inch diameter shank, length to suit depth of insulation indicated.
 4. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
- D. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick, stainless-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. AGM Industries, Inc.; RC-150.
 - b. GEMCO; R-150.
 - c. Midwest Fasteners, Inc.; WA-150.
 - d. Nelson Stud Welding; Speed Clips.
 2. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
- E. Staples: Outward-clinching insulation staples, nominal 3/4-inch wide, stainless steel or Monel.
- F. Wire: 0.080-inch nickel-copper alloy 0.062-inch soft-annealed, stainless steel.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. C & F Wire.
 - b. Or Equal.

2.12 CORNER ANGLES

- A. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316.
- B. PVC Corner Angels: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D1784, Class 16354-C. White or color coded to match adjacent surface.
- C. Aluminum Corner Angels: 0.040 inch thick, minimum 1 by 1 inch aluminum according to ASTM B209, Alloy 3003, Temper H-14.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.
 1. Verify that systems to be insulated have been tested and are free of defects before applying insulation materials.
 2. Verify that surfaces to be insulated are clean and dry, with foreign material removed.
 3. Proceed with installation only after unsatisfactory conditions have been corrected to the satisfactory of the owner
 4. Pressure and leak test all piping and ductwork and obtain review and acceptance prior to the application of insulation.

3.2 PREPARATION

- A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.
- B. Before insulating, apply a corrosion resistant coating to insulated surfaces as follows:
 1. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300°F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
 2. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg. F Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
- C. Mix insulating cements with clean portable water; if insulating cements are to be in contact with stainless steel surfaces, use demineralized water.
- D. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings and piping including fittings, valves, and specialties.
- B. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and piping system as specified in insulation system schedules.
- C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Install insulation with longitudinal seams at top and bottom of horizontal runs.
- E. Install multiple layers of insulation with longitudinal and end seams staggered.
- F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.
- G. Keep insulation materials dry during application and finishing.
- H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.
- I. Install insulation with least number of joints practical.
- J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
 - 1. Install insulation continuously through hangers and around anchor attachments.
 - 2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
 - 3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
 - 4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.
- K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.
- L. Install insulation with factory-applied jackets as follows:
 - 1. Draw jacket tight and smooth.
 - 2. Cover circumferential joints with 3-inch wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
 - 3. Overlap jacket longitudinal seams at least 1-1/2 inches. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
 - 4. For below ambient services, apply vapor-barrier mastic over staples.
 - 5. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
 - 6. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct flanges and fittings.

- M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.
- N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.
- O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.
- P. Duct liner may not be used as a sole means of insulation. It may only be used where required by the acoustic engineer, and on a case-by-case basis; its presence may allow the reduction of external duct insulation if equivalent R value is maintained. All instances shall be submitted by a single RFI for approval of intent.

3.4 PENETRATIONS

- A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
 - 4. Seal jacket to roof flashing with flashing sealant.
- B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
 - 1. Seal penetrations with flashing sealant.
 - 2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
 - 3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
 - 4. Seal jacket to wall flashing with flashing sealant.
- C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.
- D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
 - 1. Comply with requirements in Section 078413 "Penetration Fire-stopping" and fire-resistant joint sealers.

3.5 INSTALLATION – EQUIPMENT, TANK, AND VESSEL INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Factory Insulated Equipment: Do not insulate.

- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Install insulation where it cannot become wet. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation
- E. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.
- F. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.
- G. Insulated equipment: Insulate entire stem. Provide vapor retarder jackets, factory-applied or field-applied. Finish with glass-cloth and vapor barrier adhesive, then apply final jacket. Insulate flanges and unions with removable sections and jackets.
- H. For cold equipment or equipment containing fluids below ambient temperature:
Insulate entire system.
Provide vapor barrier jackets, factory applied or field applied.
Finish with glass cloth and vapor barrier adhesive.
Cover with PVC jacket where specified.
- I. For equipment containing fluids above ambient temperature:
 - 1. Insulate entire system.
 - 2. Insulate flanges and unions with removable sections and jackets.
 - 3. Provide standard jackets, with or without vapor barrier, factory applied or field applied.
 - 4. Finish with glass cloth and adhesive and cover with PVC jacket where specified or provide facing as 1 inch galvanized or stainless steel hexagonal wire mesh stitched on one face of insulation.
- J. Finish insulation at supports, protrusions, and interruptions.
- K. Equipment in Mechanical Equipment Rooms or Exposed in Finished Spaces: Finish with canvas jacket sized for finish painting or PVC jacket and fitting covers as scheduled.
- L. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- M. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement of pipe accessories or valving without damage to surrounding insulation.
- N. Insulate all equipment including valves, etc., throughout the chilled water system.
- O. Insulate all equipment including valves, etc., throughout the steam and hot water piping systems
- P. Glass Fiber, Pipe and Tank Insulation Installation for Tanks and Vessels: Secure insulation with adhesive and anchor pins and speed washers.
 - 1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of tank and vessel surfaces.
 - 2. Groove and score insulation materials to fit as closely as possible to equipment, including contours. Bevel insulation edges for cylindrical surfaces for tight joints. Stagger end joints.
 - 3. Protect exposed corners with secured corner angles.
 - 4. Install adhesively attached or self-sticking insulation hangers and speed washers on sides of tanks and vessels as follows:
 - a. Do not weld anchor pins to ASME-labeled pressure vessels.
 - b. Select insulation hangers and adhesives that are compatible with service temperature and with substrate.

- c. On tanks and vessels, maximum anchor-pin spacing is 3 inches (75 mm) from insulation end joints, and 16 inches (400 mm) o.c. in both directions.
 - d. Do not overcompress insulation during installation.
 - e. Cut and miter insulation segments to fit curved sides and domed heads of tanks and vessels.
 - f. Impale insulation over anchor pins and attach speed washers.
 - g. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 - 5. Secure each layer of insulation with stainless-steel or aluminum bands. Select band material compatible with insulation materials.
 - 6. Where insulation hangers on equipment and vessels are not permitted or practical and where insulation support rings are not provided, install a girdle network for securing insulation. Stretch prestressed aircraft cable around the diameter of vessel and make taut with clamps, turnbuckles, or breather springs. Place one circumferential girdle around equipment approximately 6 inches (150 mm) from each end. Install wire or cable between two circumferential girdles 12 inches (300 mm) o.c. Install a wire ring around each end and around outer periphery of center openings, and stretch prestressed aircraft cable radially from the wire ring to nearest circumferential girdle. Install additional circumferential girdles along the body of equipment or tank at a minimum spacing of 48 inches (1200 mm) o.c. Use this network for securing insulation with tie wire or bands.
 - 7. Stagger joints between insulation layers at least 3 inches (75 mm).
 - 8. Install insulation in removable segments on equipment access doors, manholes, handholes, and other elements that require frequent removal for service and inspection.
 - 9. Bevel and seal insulation ends around manholes, handholes, ASME stamps, and nameplates.
 - 10. For equipment with surface temperatures below ambient, apply mastic to open ends, joints, seams, breaks, and punctures in insulation.
- Q. Flexible Elastomeric Thermal Insulation Installation for Tanks and Vessels: Not allowed except if it comes factory applied on vessels.
- R. Provide insulation as required for all packaged equipment whether furnished with the equipment or not.

3.6 INSTALLATION – PIPE INSULATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Insulation shall be continuous using full length sections of pre-molded insulation only. Multiple short length sections on straight piping shall not be accepted. Butt edges neatly, with minimum 3-inch butt strips.
- C. Exposed Piping: Locate insulation and cover seams in least visible locations.
- D. Install insulation where it cannot become wet. If insulation becomes wet, remove and dispose of properly and replace with new, dry insulation. Wetted insulation is not acceptable. Ensure insulation is dry before and during installation.
- E. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, and expansion joints.
- F. Glass fiber insulated pipes conveying fluids below ambient temperature:
 - 1. Furnish factory-applied or field-applied vapor retarder jackets. Secure factory-applied jackets with pressure sensitive adhesive self-sealing longitudinal laps and butt strips. Secure

- field-applied jackets with outward clinch expanding staples and seal staple penetrations with vapor retarder mastic.
2. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor retarder adhesive or PVC fitting covers, as scheduled. Ensure that insulation at devices requiring access is cut in prefabricated sections to allow easy removal for maintenance activities.
- G. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
 2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers, as scheduled. Ensure that insulation at devices requiring access is cut in prefabricated sections to allow easy removal for maintenance activities.
- H. Pre-Insulated Pipe Support Inserts and Shields:
1. Application: Piping or Equipment
 2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
 3. Insert location: Between support shield and piping and under finish jacket.
 4. Insert configuration: Minimum 12 inches (300 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.
 5. Insert material: Calcium Silicate.
 6. Vapor retarding jacket: To match adjacent piping
- I. Insulation shall be continuous when passing through sleeves or other openings,
- J. Continue insulation through penetrations of building assemblies or portions of assemblies having fire resistance rating of one hour or less. Provide firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions.
- K. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with aluminum jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.
- L. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
 2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
 3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
 4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Valve shall have extended stem to allow for insulation. Fill joints, seams, and irregular surfaces with insulating cement.
 5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation

- by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strain-ers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide an insulation cover that is removable and reusable with-out damage. For below ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
 7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
 8. For services not specified to receive a field-applied jacket except for flexible elastomeric, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
 9. Stencil or label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.
 10. For fittings and accessories requiring servicing or inspection, insulation shall be removable and replaceable without damage. Enclose within two-piece no. 15 gauge aluminum covers fastened with cadmium-plated bolts and nuts.
- M. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connec-tion with insulating cement and finish with finishing cement, mastic, and flashing sealant.
- N. Install removable insulation covers at locations requiring maintenance access. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thick-ness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
 2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
 3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
 4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches (50 mm) over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insu-lation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

3.7 INSTALLATION – DUCT INSULATION

- A. Insulated ductwork:
1. Provide insulation with vapor retarder jackets.
 2. Finish with tape and vapor retarder jacket.
 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 4. Insulate entire system including fittings, joints, flanges, volume dampers and duct silencers. Do not insulate ductwork equipment where insulation will adversely affect operation and/or listing of equipment. Do not insulate fire dampers and smoke fire dampers. Where duct support is in contact with a duct requiring insulation, also insulate the support within 6 inches of the contact point.
 5. Where service access is required, bevel and seal ends of insulation.

B. Duct Insulation Application:

1. Provide 100% coverage on adhesive, weld ping at 16" on center with at least one central line of pins per side ductwork smaller than 18". Provide pins within 3" of insulation joints/laps.
2. Secure insulation with continuous vapor retarder and seal jacket joints with vapor retarder adhesive or tape to match jacket.
3. Secure insulation without vapor retarder with tape.
4. Install without sag on underside of ductwork. Use adhesive or mechanical fasteners in addition to the requirements above where necessary to prevent sagging. Lift ductwork off trapeze hangers and insert spacers and insulation board.
5. Seal vapor retarder penetrations by mechanical fasteners with vapor retarder adhesive.
6. Stop and finish insulation around access doors and damper operators to allow operation without disturbing wrapping.
7. Provide continuous finishing jacket as noted in Part 3.

C. Trapeze Support of Duct Insulation Application

1. Provide a 12 inch long full width section of 6 lb/cu ft (90 kg/cu m) insulation board under the duct between the sheet metal and trapeze as a duct support insert.

D. Tape adjacent flexible insulation to board and seal.

3.8 INSTALLATION – GLASS FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with Glass-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.

3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
 4. Install insulation to flanges as specified for flange insulation application.
- E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor discharge-weld pins on all sides of ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), place pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Do not overcompress insulation during installation. Allow maximum fullness at corners, minimum thickness at corners shall be 1 inch.
 - d. Impale insulation over pins and attach speed washers.
 - e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperature below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2-inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field applied jacket, adhesive vapor barrier mastic, and sealant at joints, seams and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Overlap unfaced blankets a minimum of 2-inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
 6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6-inches o.c.
 8. Finish insulation neatly at hangers, supports and other protrusions.
 9. Locate insulation cover seams in the least visible location.
 10. Where ducts cannot be insulated after erection, insulate prior to installation.
 11. Where specified thickness of insulation exceeds available thickness in single layer, provide insulation 1 2 or more layers with joints staggered.

- F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area for 100 percent coverage of duct and plenum surfaces.
 2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transition.
 3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on all sides of ducts as follows:
 - a. On duct sides with dimensions 18 inches (450 mm) and smaller, place pins along longitudinal centerline of duct. Space 3 inches (75 mm) maximum from insulation end joints, and 16 inches (400 mm) o.c.
 - b. On duct sides with dimensions larger than 18 inches (450 mm), space pins 16 inches (400 mm) o.c. each way, and 3 inches (75 mm) maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
 - c. Do not overcompress insulation during installation.
 - d. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
 4. For ducts and plenums with surface temperature below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1-inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
 - a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
 - b. Install vapor stops for ductwork and plenums operating below 50 deg F (10 deg C) at 18-foot (5.5-m) intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches (75 mm).
 5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
 6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch wide strips of same material used to insulate duct. Secure on alternating sides of stiffeners, hangers, and flanges with pins spaced 6-inches o.c.
 7. Seal all joints and pin penetrations with pressure sensitive aluminum foil tape. Reinforce all exposed edges with corner bead.

3.9 INSTALLATION – FLEXIBLE ELASTOMERIC INSULATION

- A. Generally used at flexible pipe connectors only, unless explicitly allowed by the Owner.
- B. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.
- C. Insulation Installation on Pipe Flanges:
1. Install pipe insulation to outer diameter of pipe flange

2. Install pipe insulation to outer diameter of pipe flange
3. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
4. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
5. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.10 FIELD-APPLIED JACKET INSTALLATION

- A. Where metal jacket is indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal longitudinal end joints with weather-proof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.
- B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
 1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.11 FIRE-RATED INSULATION SYSTEM INSTALLATION

- A. Fire barrier wrap and insulation shall comply with the installation requirements of the fire-tested assembly and recommendations of the manufacturer, including access door installation.
- B. Where fire-rated insulation system is indicated, secure system to ducts and duct hangers and supports to maintain a continuous fire rating.
- C. Insulate duct access panels and doors to achieve same fire rating as duct.

3.12 FINISHES

- A. Coordinate first paragraph below with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting." If PVC jackets are specified, consult jacket manufacturers to determine suitable paint products and revise painting Sections to suit Project.
- B. Do not field paint aluminum or stainless-steel jackets.

3.13 FIELD QUALITY CONTROL

- A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.
- B. Perform tests and inspections.
 1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each duct system.
 2. Inspect field insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location(s) for each type of equipment. For large equipment, remove only a portion adequate to determine compliance.
 3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three location(s) of pipe, three locations of threaded fittings,

three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe.

- C. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

3.14 DUCT INSULATION SCHEDULE, GENERAL

A. Ducts Insulation Schedule:

Duct Type	Location	Insulation type	Field-Applied Protective Jacket or Paint
All supply and return ductwork.	Outdoors aboveground	Glass fiber board, 3 lb/cu ft., 2" thick min. R-8	Aluminum
All supply and return ductwork	In shafts and in mechanical rooms at heights below 8'.	Glass fiber board, 3 lb/cu ft., 2" thick min, R-8	None
All supply and return ductwork	At duct supports	Glass fiber board, 6 lb/cu ft., 2" thick min. R-8	None
All supply air ductwork	Indoors exposed to view	Glass fiber blanket, 1.5 lb/cu ft, 2" thick, PSK white surface, min. R4.2	None
All supply air ductwork	Indoors, except as noted above.	Glass fiber blanket, 1.5 lb/cu ft, 2" thick min. R-4.2	None
All outside air, All elevated temperature exhaust that is not already in fire wrap	Located in ceiling plenums	Glass fiber blanket, 1.5 lb/cu ft, 2" thick, FSK Foil Surface,	None
Return Air	Located in ceiling plenum or exposed	None	Either bare or Paint color by architect

Schedule Notes:

1. "Ductwork" includes any plenums.
2. Insulation thickness may be reduced at fire rated wall penetrations to suit requirements of UL Listed fire stop system. Reduced insulation thickness shall apply with a maximum of 12 inches of the wall penetration.
3. Pre-jacketed piping with metallic surface such as that provided by VentureClad is also acceptable.

3.15 EQUIPMENT INSULATION SCHEDULE

Indoor Equipment	Insulation Type	Jacket Type
Air separator, expansion tank, pot feeder	1.5" thick rigid glass fiber	PVC
Heating Hot Water Pipeline Equipment (Valves, Flanges, etc.)	1.5" thick rigid glass fiber	PVC
Pumps	2" thick rigid glass fiber	Pre-molded Cover with vapor barrier if chilled water services

3.16 PIPING INSULATION SCHEDULE

A. Piping insulation type.

System	Temp Range (°F)	Insulation Material	1" and Less	1¼" TO 2"	2½" TO 6"	8" & UP
Heating Hot Water	120 to 200	Pre-formed glass fiber	1.5" (0.5" on final runouts less than 12' in length)	1.5"	1.5"	1.5"
Refrigerant piping	35 to 115	Preformed glass fiber	0.5"	0.5"		
Cold Condensate Drain	45 to 55	Closed cell elastomeric foam	0.5"	0.5"	0.5"	0.5"
Support Insert	Up to 250	Calcium Silicate	Per sizes above to match adjacent.			

B. Pipe, Valve, and Fitting Cover Schedule

Pipe Type	Location Type	Insulation Type	Field-Applied Protective Jacket
Heating Hot Water	All piping not covered below.	Pre-formed Fiberglass Rigid	PVC, Orange
	Exposed piping 8' and below.	Pre-formed Fiberglass Rigid	PVC, Orange
	Outdoors	Pre-formed Fiberglass Rigid	Aluminum

C. HVAC Piping Insulation Application

Service	Jacket Type
Heating Hot Water Piping (120°F to 180°F)	Outdoors: Aluminum Exposed Indoors: white kraft paper ASJ, PVC at elbows and below 8' in mechanical rooms Concealed Indoors: ASJ
Cold condensate drains	Outdoors: aluminum Exposed Indoors: white kraft paper ASJ, PVC at elbows and below 8' in mechanical rooms Concealed Indoors: None

- The valving set on final branch reheat coils only may be left without insulation to allow for easy access and visible inspection of the valve and flexible pipe connection. This is not allowed for chilled water piping or valving anywhere in the building.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

- Possible variations of jackets by location are endless. This article specifies locations in two broad categories: concealed and exposed. Revise if additional delineation is necessary.
- 30-mil (0.8-mm) or heavier PVC is recommended for outdoor applications. 40-mil (1.0-mm) PVC does not meet a flame-spread index of 25 and a smoke-developed index of 50; however, a flame-spread or smoke-developed index is not a requirement for outdoor applications.

- C. 0.024-inch (0.61-mm) or heavier aluminum is recommended for outdoor applications.
- D. Painted aluminum increases surface emissivity and provides added chemical resistance. See Evaluations for discussion of emissivity.
- E. 0.016-inch (0.41-mm) or heavier stainless steel is recommended for outdoor applications.
- F. Z-shaped locking seam is recommended for metal jackets located in unprotected applications that are exposed to severe weather.
- G. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.
- H. If more than one material is listed, selection from materials listed is Contractor's option.
 - 1. Ducts and Plenums, Exposed, up to 48 Inches in Diameter or with Flat Surfaces up to 72 Inches:
 - a. Painted Aluminum, Smooth: 0.020 inch thick.
 - 2. Ducts and Plenums, Exposed, Larger Than 48 Inches in Diameter or with Flat Surfaces Larger Than 72 Inches:
 - a. Painted Aluminum, Smooth with 4-by-1-Inch Box Ribs: 0.040 inch thick.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building Management System (BMS), utilizing direct digital controls.

1.2 RELATED WORK SPECIFIED ELSEWHERE

- A. Products Supplied but Not Installed Under This Section:
 - 1. Control valves.
 - 2. Flow switches.
 - 3. Wells, sockets, and other inline hardware for water sensors (temperature, pressure, flow).
 - 4. Automatic control dampers, where not supplied with equipment.
 - 5. Airflow measuring stations.
 - 6. Terminal unit controllers and actuators, when installed by terminal unit manufacturer.
 - 7. Variable frequency drives. (This does not include VFDs integral to machinery such as chillers or boilers).
- B. Products Installed but Not Supplied Under This Section:
 - 1. None.
- C. Products Not Furnished or Installed but Integrated with the Work of This Section:
 - 1. Chiller control systems (if applicable).
 - 2. Boiler control systems.
 - 3. Pump control packages.
 - 4. In-line meters (gas, water, power).
 - 5. Refrigerant monitors.
 - 6. Chemical water treatment.
 - 7. Smoke detectors (through alarm relay contacts).
 - 8. Air handling systems
 - 9. Exhaust systems and makeup air systems.
 - 10. Space pressure control and monitoring.
- D. Work Required Under Other Divisions Related to This Section:
 - 1. Power wiring to line side of motor starters, disconnects or variable frequency drives.
 - 2. Provision and wiring of smoke detectors and other devices relating to fire alarm system.
 - 3. Campus LAN (Ethernet) connection adjacent to JACE network management controller.

1.3 RELATED SECTIONS

- A. Section 230000 - Basic Mechanical Requirements.

1.4 SYSTEM DESCRIPTION

- A. Scope: Furnish all labor, materials and equipment necessary for a complete and operating Building Management System (BMS), utilizing Direct Digital Controls as shown on the drawings and as described herein. Drawings are diagrammatic only. All controllers furnished in this section shall communicate on a peer-to-peer bus over an open protocol bus (Examples: LonTalk, BACnet, MODBUS).
 - 1. The intent of this specification is to provide a system that is consistent with BMS systems throughout the owner's facilities running the Niagara 4 Framework.
 - 2. System architecture shall fully support a multi-vendor environment and be able to

- integrate third party systems via existing vendor protocols including, as a minimum, LonTalk, BACnet and MODBUS.
3. System architecture shall provide secure Web access using any of the current versions of Microsoft Internet Explorer, Mozilla Firefox, or Google Chrome browsers from any computer on the owner's LAN.
 4. All control devices furnished with this Section shall be programmable directly from the Niagara 4 Workbench embedded toolset upon completion of this project. The use of configurable or programmable controllers that require additional software tools or tools that require a specific Niagara 4 license brand to operate for post-installation maintenance shall not be acceptable.
 5. Any control vendor that shall provide additional BMS server software shall be unacceptable. Only systems that utilize the Niagara 4 Framework shall satisfy the requirements of this section.
 6. The BMS server shall host all graphic files for the control system. All graphics and navigation schemes for this project shall match those that are on the existing campus NiagaraAX or Niagara 4 Framework server.
 7. A laptop computer including engineering/programming software to modify Operating System Server BMS programs and graphics shall be included.
 8. Owner shall receive all Administrator level login and passwords for engineering toolset at first training session. The Owner shall have full licensing and full access rights for all network management, operating system server, engineering and programming software required for the ongoing maintenance and operation of the BMS.
 9. OPEN NIC STATEMENTS - All Niagara 4 software licenses shall have the following NiCS: "accept.station.in=*"; "accept.station.out=*" and "accept.wb.in=*" and "accept.wb.out=*". All open NIC statements shall follow Niagara Open NIC specifications.
 10. All JACE hardware licenses and certificates shall be stored on local MicroSD memory card employing encrypted "safe boot" technology.
 11. To ensure quality, any JACE 8 hardware products used on this project shall come through the Tridium Richmond, VA shipping facility. JACE hardware products not meeting this requirement will not be allowed.
 12. BMS shall provide trends for all hard and soft points for all integration (i.e. VFD, boiler, etc)
- B. All products of the BMS shall be provided with the following agency approvals. Verification that the approvals exist for all submitted products shall be provided on request, with the submittal package. Systems or products not currently offering the following approvals are not acceptable.
1. Federal Communications Commission (FCC), Rules and Regulations, Volume II -July 1986 Part 15 Class A Radio Frequency Devices.
 2. FCC, Part 15, Subpart B, Class B
 3. FCC, Part 15, Subpart C
 4. FCC, Part 15, Subpart J, Class A Computing Devices.
 5. UL 504 - Industrial Control Equipment.
 6. UL 506 - Specialty Transformers.
 7. UL 910 - Test Method for Fire and Smoke Characteristics of Electrical and Optical-Fiber Cables Used in Air-Handling Spaces.
 8. UL 916 - Energy Management Systems All.
 9. UL 1449 - Transient Voltage Suppression.
 10. Standard Test for Flame Propagation Height of Electrical and Optical - Fiber Cables Installed Vertically in Shafts.
 11. EIA/ANSI 232-E - Interface Between Data Technical Equipment and Data Circuit Terminal Equipment Employing Serial Binary Data Interchange.
 12. EIA 455 - Standard Test Procedures for Fiber Optic Fibers, Cables, Transducers, Connecting and Terminating Devices.

13. IEEE C62.41- Surge Voltages in Low-Voltage AC Power Circuits.
14. IEEE 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.
 - a. NEMA 250 - Enclosures for Electrical Equipment.
15. NEMA ICS 1 - Industrial Controls and Systems.
16. NEMA ST 1 - Specialty Transformers.
17. NCSBC Compliance, Energy: Performance of control system shall meet or surpass the requirements of ASHRAE/IESNA 90.1-1999.
18. CE 61326
19. C-Tick
20. cUL

1.5 SPECIFICATION NOMENCLATURE

- A. Acronyms used in this specification are as follows:
1. Actuator: Control device that opens or closes valve or damper in response to control signal.
 2. AI: Analog Input.
 3. AO: Analog Output.
 4. Analog: Continuously variable state over stated range of values.
 5. BMS: Building Management System.
 6. DDC: Direct Digital Control.
 7. Discrete: Binary or digital state.
 8. DI: Discrete Input.
 9. DO: Discrete Output.
 10. FC: Fail Closed position of control device or actuator. Device moves to closed position on loss of control signal or energy source.
 11. FO: Fail open (position of control device or actuator). Device moves to open position on loss of control signal or energy source.
 12. GUI: Graphical User Interface.
 13. HVAC: Heating, Ventilating and Air Conditioning.
 14. IDC: Interoperable Digital Controller.
 15. ILC: Interoperable Lon Controller.
 16. LAN: Local Area Network.
 17. Modulating: Movement of a control device through an entire range of values, proportional to an infinitely variable input value.
 18. Motorized: Control device with actuator.
 19. NAC: Network Area Controller.
 20. NC: Normally closed position of switch after control signal is removed or normally closed position of manually operated valves or dampers.
 21. NO: Normally open position of switch after control signal is removed; or the open position of a controlled valve or damper after the control signal is removed; or the usual position of a manually operated valve.
 22. OSS: Operating System Server, host for system graphics, alarms, trends, etc.
 23. Operator: Same as actuator.
 24. PC: Personal Computer.
 25. Peer-to-Peer: Mode of communication between controllers in which each device connected to network has equal status and each shares its database values with all other devices connected to network.
 26. P: Proportional control; control mode with continuous linear relationship between observed input signal and final controlled output element.
 27. PI: Proportional-Integral control, control mode with continuous proportional output plus additional change in output based on both amount and duration of change in controller variable (reset control).
 28. PICS: BACnet Product Interoperability Compliance Statement.

- 29. PID: Proportional-Integral-Derivative control, control mode with continuous correction of final controller output element versus input signal based on proportional error, its time history (reset) and rate at which it's changing (derivative).
- 30. Point: Analog or discrete instrument with addressable database value.
- 31. WAN: Wide Area Network.

1.6 SUBMITTALS

- A. Submit under provisions of Section 013000.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Submit documentation of contractor qualifications, including those indicated in "Quality Assurance" if requested by the A-E.
- D. X copies of shop drawings of the entire control system shall be submitted and shall consist of a complete list of equipment and materials, including manufacturers' catalog data sheets and installation instructions. Submit in printed electronic format. Samples of written Controller Checkout Sheets and Performance Verification Procedures for applications similar in scope shall be included for approval.
- E. Shop drawings shall also contain complete wiring and schematic diagrams, sequences of operation, control system bus layout and any other details required to demonstrate that the system has been coordinated and will properly function as a system. Terminal identification for all control wiring shall be shown on the shop drawings.
- F. Upon completion of the work, provide x complete sets of 'as-built' drawings and other project-specific documentation in 3-ring hard-backed binders and on Flash media.
- G. Any deviations from these specifications or the work indicated on the drawings shall be clearly identified in the Submittals.

1.7 QUALITY ASSURANCE

- A. The Control System Contractor shall have a full service DDC office within 50 miles of the job site. This office shall be staffed with applications engineers, software engineers and field technicians. This office shall maintain parts inventory and shall have all testing and diagnostic equipment necessary to support this work, as well as staff trained in the use of this equipment.
- B. Single Source Responsibility of Supplier: The Control System Contractor shall be responsible for the complete installation and proper operation of the control system. The Control System Contractor shall exclusively be in the regular and customary business of design, installation and service of computerized building management systems similar in size and complexity to the system specified. The Control System Contractor shall be the manufacturer of the primary DDC system components or shall have been the authorized representative for the primary DDC components manufacturer for at least 5 years. All control panels shall be assembled by the Control System Contractor in a UL-Certified 508A panel shop.
- C. Equipment and Materials: Equipment and materials shall be cataloged products of manufacturers regularly engaged in the production and installation of HVAC control systems. Products shall be manufacturer's latest standard design and have been tested and proven in actual use.

1.8 PRE-INSTALLATION MEETINGS

- A. Convene minimum two weeks prior to starting work of this section.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Maintain integrity of shipping cartons for each piece of equipment and control device through shipping, storage and handling as required to prevent equipment damage. Store equipment and materials inside and protected from weather.

1.10 JOB CONDITIONS

- A. Cooperation with Other Trades: Coordinate the Work of this section with that of other sections to insure that the Work will be carried out in an orderly fashion. It shall be this Contractor's responsibility to check the Contract Documents for possible conflicts between his Work and that of other crafts in equipment location, pipe, duct and conduit runs, electrical outlets and fixtures, air diffusers and structural and architectural features.

1.11 SEQUENCING

- A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Tridium N4 Operation System
- B. Or Approved Equal. Final approval from client is needed for all "Approved Equal" product proposed to use.

2.2 GENERAL

- A. The Building Management System (BMS) shall be comprised of a network of interoperable, stand-alone digital controllers, a network area controller, graphics and programming and other control devices for a complete system as specified herein.
- B. All software programming and commissioning tools for graphical user interface, network controllers, and field controllers will be made available to the owner's facilities and maintenance staff. Extensive training classes and details will also be made available with close out documentation.
- C. The installed system shall provide secure strong password access to all features, functions and data contained in the overall BMS.

2.3 OPEN, INTEROPERABLE, INTEGRATED ARCHITECTURE

- A. The intent of this specification is to provide a peer-to-peer networked, stand-alone, distributed control system utilizing Open protocols in one open, interoperable system.
- B. The supplied computer software shall employ object-oriented technology (OOT) for representation of all data and control devices within the system. Physical connection of any BACnet control equipment, such as chillers, shall be via Ethernet or IP.
- C. All components and controllers supplied under this contract shall be true "peer-to-peer" communicating devices. Components or controllers requiring "polling" by a host to pass data

shall not be acceptable.

- D. The supplied system shall incorporate the ability to access all data using HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. An Open Database Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on the Operating System Server located in the Facilities Office on the LAN. Systems requiring proprietary database and user interface programs shall not be acceptable.
- E. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
 - 1. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 5 seconds for network connected user interfaces.
 - 2. Maximum acceptable response time from any alarm occurrence (at the point of origin) to the point of annunciation shall not exceed 60 seconds for remote or dial-up connected user interfaces.

2.4 BAS SERVER HARDWARE

- A. Minimum Computer Configuration (Hardware Independent).
 - 1. Central Server. Owner shall provide a dedicated BAS server with configuration that includes the following components as a minimum:
 - 2. Processor: Intel Xeon CPU E5-2640 x64 (or better), compatible with dual- and quad-core processors.
 - 3. Memory: 2 GB or more recommended for large systems, 8 GB or more recommended for the Windows 64-bit version.
 - 4. Hard Drive: 4 GB minimum, more recommended depending on archiving requirements.
 - 5. Display: Video card and monitor capable of displaying 1024 x 768-pixel resolution or greater.
 - 6. Network Support: Ethernet adapter (10/100 Mb with RJ-45 connector).
 - 7. Connectivity: Full-time high-speed ISP connection recommended for remote site access (i.e., T1, ADSL, cable modem).
- B. Standard Client: The thin-client Web Browser BAS GUI shall be Microsoft Internet Explorer (10.0 or later) running on Microsoft 7+. No special software shall be required to be installed on the PCs used to access the BAS via a web browser.

2.5 SYSTEM NETWORK CONTROLLER (SNC)

- A. Manufacturers:
 - 1. Tridium JACE 8000
- B. These controllers are designed to manage communications between the programmable equipment controllers (PEC), application specific controllers (ASC) and advanced unitary controllers (AFC) which are connected to its communications trunks, manage communications between itself and other system network controllers (SNC) and with any operator workstations (OWS) that are part of the BAS, and perform control and operating strategies for the system based on information from any controller connected to the BAS.
- C. The controllers shall be fully programmable to meet the unique requirements of the facility it shall control.

- D. The controllers shall be capable of peer-to-peer communications with other SNC's and with any OWS connected to the BAS, whether the OWS is directly connected, connected via cellular modem or connected via the Internet.
- E. The communication protocols utilized for peer-to-peer communications between SNC's will be Niagara 4 Fox, BACnet TCP/IP and SNMP. Use of a proprietary communication protocol for peer-to-peer communications between SNC's is not allowed.
- F. The SNC shall employ a device count capacity license model that supports expansion capabilities.
- G. The SNC shall be enabled to support and shall be licensed with the following Open protocol drivers (client and server) by default:
 - 1. BACnet
 - 2. Lon
 - 3. MODBUS
 - 4. SNMP
 - 5. KNX
- H. The SNC shall be capable of executing application control programs to provide:
 - 1. Calendar functions.
 - 2. Scheduling.
 - 3. Trending.
 - 4. Alarm monitoring and routing.
 - 5. Time synchronization.
 - 6. Integration of LonWorks, BACnet, and MODBUS controller data.
 - 7. Network management functions for all SNC, PEC and ASC based devices.
- I. The SNC shall provide the following hardware features as a minimum:
 - 1. Two 10/100 Mbps Ethernet ports.
 - 2. Two Isolated RS-485 ports with biasing switches.
 - 3. 1 GB RAM
 - 4. 4 GB Flash Total Storage / 2 GB User Storage
 - 5. Wi-Fi (Client or WAP)
 - 6. USB Flash Drive
 - 7. High Speed Field Bus Expansion
 - 8. -20-60°C Ambient Operating Temperature
 - 9. Integrated 24 VAC/DC Global Power Supply
 - 10. MicroSD Memory Card Employing Encrypted Safe Boot Technology
- J. The SNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 16 simultaneous users.
- K. The SNC shall provide alarm recognition, storage, routing, management and analysis to supplement distributed capabilities of equipment or application specific controllers.
- L. The SNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via cellular modem, or wide-area network.
 - 1. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but not limited to:
 - a. Alarm.
 - b. Return to normal.
 - c. To default.
 - 2. Alarms shall be annunciated in any of the following manners as defined by the user:
 - a. Screen message text.
 - b. Email of complete alarm message to multiple recipients.

- c. Pagers via paging services that initiate a page on receipt of email message.
 - d. Graphics with flashing alarm object(s).
 - 3. The following shall be recorded by the SNC for each alarm (at a minimum):
 - a. Time and date.
 - b. Equipment (air handler #, access way, etc.).
 - c. Acknowledge time, date, and user who issued acknowledgement.
- M. Programming software and all controller "Setup Wizards" shall be embedded into the SNC.
- N. The SNC shall support the following security functions.
 - 1. Module code signing to verify the author of programming tool and confirm that the code has not been altered or corrupted.
 - 2. Role-Based Access Control (RBAC) for managing user roles and permissions.
 - 3. Require users to use strong credentials.
 - 4. Data in Motion and Sensitive Data at Rest be encrypted.
 - 5. LDAP and Kerberos integration of access management.
- O. The SNC shall support the following data modeling structures to utilize Search; Hierarchy; Template; and Permission functionality:
 - 1. Metadata: Descriptive tags to define the structure of properties.
 - 2. Tagging: Process to apply metadata to components
 - 3. Tag Dictionary
- P. The SNC shall employ template functionality. Templates are a containerized set of configured data tags, graphics, histories, alarms... that are set to be deployed as a unit based upon manufacturer's controller and relationships. All lower level communicating controllers (PEC, AUC, AVAV, VFD...) shall have an associated template file for reuse on future project additions.
- Q. The SNC shall be provided with a 5 Year Software Maintenance license. Labor to implement not included.

2.6 FIELD CONTROLLER (FC)

- A. Manufacturers:
 - 1. Honeywell Spyder: The latest version available.
 - 2. Or Approved Equal
 - a. All other approved equal manufacturers must be able perform pass-thru programming from field controller to Tridium JACE Niagara framework. Pass-thru explicitly requires no intermediate drivers for field controller programming thru the Tridium Niagara Front End.
 - b. Final approval from the client is needed for all "Approved Equal" products proposed to use.
- B. Native BACnet controller shall be used for these applications.
- C. Expandable application controller shall be capable of providing control strategies for the system based on information from any or all connected inputs. The program that implements these strategies shall be completely flexible and user definable. Any systems utilizing factory pre-programmed global strategies that cannot be modified by field personnel on-site via simple download are not acceptable. Changing global strategies via firmware changes is also unacceptable. Program execution of controller shall be a minimum of once per second.
- D. Programming shall be object-oriented using control program blocks. Controller shall support a minimum of 500 Analog Values and 500 Binary Values. Each and every analog and binary value shall support standard BACnet priority arrays. Programming tool shall be provided

with system and shall be the same tool that is used to program the Building Controller. All flowcharts shall be generated and automatically downloaded to controller. No re-entry of database information shall be necessary.

- E. Provide means to graphically view inputs and outputs to each program block in real-time as program is executing. This function may be performed via the operator's terminal or field computer.
- F. Controller shall have adequate data storage to ensure high performance and data reliability. Battery shall retain its static RAM memory and real-time clock functions for a minimum of 1.5 years (cumulative). Battery shall be a field-replaceable (non-rechargeable) lithium type. Unused battery life shall be 10 years.
- G. The onboard, battery-backed real time clock must support schedule operations and trend logs.
- H. Global control algorithms and automated control functions should execute via 32-bit processor.
- I. Controller shall include both on-board 10BASE-T/100BASE-TX Ethernet BACnet communication over twisted pair cable (UTP) and shall include BACnet IP communication. In addition, controller shall include BACnet PTP connection port.
- J. The base unit of the controller shall host up to 8 expansion modules with various I/O combinations. These inputs and outputs shall include universal 12-bit inputs, binary triac outputs, and 8-bit switch selectable analog outputs (0-10V or 0-20 mA). Inputs shall support 3K and 10K thermistors, 0-5VDC, 0-10VDC, 4-20mA, dry contacts and pulse inputs directly.
- K. All outputs must have onboard Hand-Off-Auto switches and a status indicator light. HOA switch position shall be monitored. Each analog output shall include a potentiometer for manually adjusting the output when the HOA switch is in the Hand position.
- L. The position of each and every HOA switch shall be available system wide as a BACnet object. Expandable Central Plant Controller shall provide up to 176 discreet inputs/outputs per base unit.
- M. BACnet Conformance:
 - 1. Controller shall as a minimum support Point-to-Point (PTP), MS/TP and Ethernet BACnet LAN types. It shall communicate directly via these BACnet LANs as a native BACnet device and shall support simultaneous routing functions between all supported LAN types. Building controller shall be a BACnet conformance class 3 device and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Clock Functional Group
 - b. Files Functional Group
 - c. Reinitialize Functional Group
 - d. Device Communications Functional Group
 - e. Event Initiation Functional Group
 - 2. Standard BACnet object types supported shall include as a minimum: Analog Input, Binary Input, Analog Output, Binary Output, Analog Value, Binary Value, Device, File, Group, Event Enrollment, Notification Class, Program and Schedule object types. All necessary tools shall be supplied for working with proprietary information.
 - 3. The Controller shall comply with Annex J of the BACnet specification for IP connections. This device shall use Ethernet to connect to the IP internetwork, while using the same Ethernet LAN for non-IP communications to other BACnet devices on

the LAN. Must support interoperability on wide area networks (WANs) and campus area networks (CANs) and function as a BACnet Broadcast Management Device (BBMD).

- N. Schedules: Controller shall support a minimum of 50 BACnet Schedule Objects.
- O. Logging Capabilities:
 - 1. Each controller shall support a minimum of 200 trend logs. Any object in the system (real or calculated) may be logged. Sample time interval shall be adjustable at the operator's workstation.
 - 2. Controller shall periodically upload trended data to system server for long term archiving if desired.
 - 3. Archived data stored in database format shall be available for use in third-party spreadsheet or database programs
- P. Alarm Generation:
 - 1. Alarms may be generated within the system for any object change of value or state either real or calculated. This includes things such as analog object value changes, binary object state changes, and various controller communication failures.
 - 2. Alarm log shall be provided for alarm viewing. Log may be viewed on-site at the operator's terminal or off-site via remote communications
 - 3. Controller must be able to handle up to 200 alarm setups stored as BACnet event enrollment objects – system destination and actions individually configurable.

2.7 VARIABLE AIR VOLUME CONTROLLER (VAV)

- A. Manufacturers:
 - 1. Honeywell Spyder: The latest version available.
 - 2. Or Approved Equal
 - a. All other approved equal manufacturers must be able perform pass-thru programming from field controller to Tridium JACE Niagara framework. Pass-thru explicitly requires no intermediate drivers for field controller programming thru the Tridium Niagara Front End.
 - b. Final approval from the client is needed for all "Approved Equal" products proposed to use.
- A. Provide one native BACnet application controller for each terminal box that adequately covers all objects listed in object list for unit. All controllers shall interface to building controller via MS/TP LAN using BACnet protocol. No gateways shall be used. Controllers shall include on board a CFM flow sensor, inputs, outputs, and programmable, self-contained logic program as needed for control of units.
- B. BACnet Conformance
 - 1. Application controllers shall as a minimum support MS/TP BACnet LAN types. They shall communicate directly via this BACnet LAN at 9.6, 19.2, 38.4 and 76.8 Kbps, as a native BACnet device. Application controllers shall be of BACnet conformance class 3 and support all BACnet services necessary to provide the following BACnet functional groups:
 - a. Files Functional Group
 - b. Reinitialize Functional Group
 - c. Device Communications Functional Group
 - 2. Please refer to Section 22.2, BACnet Functional Groups, in the BACnet standard, for

- a complete list of the services that must be directly supported to provide each of the functional groups listed above. All proprietary services, if used in the system, shall be thoroughly documented, and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
3. Standard BACnet object types supported shall include as a minimum—Analog Input, Analog Output, Analog Value, Binary Input, Binary Output, Binary Value, Device, File and Program Object Types. All proprietary object types, if used in the system, shall be thoroughly documented, and provided as part of the submittal data. All necessary tools shall be supplied for working with proprietary information.
- C. Application controllers shall include universal inputs with 10-bit resolution that can accept 3K and 10K thermistors, 0–5 VDC, and dry contact signals. Inputs on controller may be either analog or digital. Controller shall also include support and modifiable programming for interface to intelligent room sensor with digital display. Controller shall also include binary outputs on board. For applications using variable speed parallel fans, provide a single analog output selectable for 0-10 V or 0-20 mA control signals. Application controller shall include microprocessor driven flow sensor for use in pressure independent control logic. All boxes shall be controlled using pressure independent control algorithms and all flow readings shall be in CFM (LPS if metric).
- 2.8 All program sequences shall be stored on board application controller in EEPROM. No batteries shall be needed to retain logic program. All program sequences shall be executed by controller 10 times per second and shall be capable of multiple PID loops for control of multiple devices. Programming of application controller shall be completely modifiable in the field over installed BACnet LANs or remotely via modem interface. Operator shall program logic sequences by graphically moving function blocks on screen and tying blocks together on screen. Application controller shall be programmed using the same programming tool as Building Controller and as described in operator workstation section. All programming tools shall be provided as part of system.
- 2.9 Application controller shall include support for the Microset II intelligent room sensor. Display on the room sensor shall be programmable at application controller and include an operating mode and a field service mode. All button functions and display data shall be programmable to show specific controller data in each mode based on which button is pressed on the sensor. See sequence for specific display requirements for intelligent room sensor.
- 2.10 On board flow sensor shall be microprocessor driven and pre-calibrated at the factory. Pre-calibration shall be at 16 flow points as a minimum. All factory calibration data shall be stored in EEPROM. Calibration data shall be field adjustable to compensate for variations in terminal box type and installation. All calibration parameters shall be adjustable through intelligent room sensor. Operator workstation, portable computers and special hand-held field tools shall not be needed for field calibration.
- 2.11 OTHER CONTROL SYSTEM HARDWARE
- A. Motorized control dampers that will not be integral to the equipment shall be furnished by the Control System Contractor. Control damper frames shall be constructed of galvanized steel, formed into channels and welded or riveted. Dampers shall be galvanized, with nylon bearings. Blade edge seals shall be vinyl. Blade edge and tip seals shall be included for all dampers. Blades shall be 16-gauge minimum and 6 inches wide maximum and frame shall be of welded channel iron. Damper leakage shall not exceed 10 CFM per square foot, at 1.5

inches water gauge static pressure.

- B. Control damper actuators shall be furnished by the Control System Contractor. Two-position or proportional electric actuators shall be direct-mount type sized to provide a minimum of 5 in-lb torque per square foot of damper area. Damper actuators shall be spring return type. Operators shall be heavy-duty electronic type for positioning automatic dampers in response to a control signal. Motor shall be of sufficient size to operate damper positively and smoothly to obtain correct sequence as indicated. All applications requiring proportional operation shall utilize truly proportional electric actuators.
- C. Control Valves:
1. Control Valves: Factory Fabricated, Of Type, Body Material, And Pressure Class Based on Maximum Pressure and Temperature Rating of Piping System, Unless Otherwise Indicated.
 2. Butterfly Valves: 200-Psig, 150-Psig (1034-Kpa) Maximum Pressure Differential, ASTM A 126 Cast-Iron or ASTM A 536 Ductile-Iron Body and Bonnet, Extended Neck, Stainless-Steel Stem, Field-Replaceable EPDM or Buna N Sleeve and Stem Seals.
 - a. Body Style: Lug.
 - b. Disc Type: Elastomer-coated ductile iron
 - c. Sizing: 1-psig maximum pressure drop at design flow rate.
 3. Characterized Ball Type
 - a. Valves shall be specifically designed for modulating duty in control application with guaranteed average leak-free life span over 200,000 full stroke cycles.
 - b. Industrial quality with nickel plated forged brass bronze bodies and female NPT threads.
 - c. Blowout proof stem design, glass-reinforced Teflon thrust seal washer and stuffing box ring with minimum 600 psi rating (2-way valves) or 400 psi rating (3-way valves). The stem packing shall consist of 2 lubricated O-rings designed for on-off, floating, or modulating service and requiring no maintenance.
 - d. Valves suitable for water or low-pressure steam shall incorporate an anti-condensation cap thermal break in stem design.
 - e. Ball: stainless steel
 - f. Stem: stainless steel
 - g. Port: Segmented design with characterizing disk held securely by a keyed ring
 4. Plug-Type Globe
 - a. Valves shall have cage-type trim, providing seating and guiding surfaces for plug on top-and-bottom guided plugs.
 - b. Temperature Rating: 25°F minimum, 250°F maximum
 - c. Body
 - 1) Bronze, screwed for 1/2 inch to 2 inch
 - 2) Cast Iron, flanged for 2-1/2 inch and larger
 - d. Valve Trim: Bronze; Stem: Polished stainless steel
 - e. Packing: Spring Loaded Teflon or Synthetic Elastomer U-cups, self-adjusting
 - f. Plug: Brass, bronze or stainless steel, Seat: Brass
 - g. Disc: Replaceable Composition or Stainless Steel Filled PTFE
 - h. Ambient Operating Temperature Limits: -10 to 150°F
 5. Minimum Valve Assembly Pressure Ratings:
 - a. Chilled water: 125 psi at 60°F
 - b. Hot water: 125 psi at 200°F.
 6. Valve Selection:
 - a. 2" and less: characterized ball valve.
 - b. 2-1/2" and greater: globe type
 7. Valve Sizing:
 - a. Minimum pressure drop equal to pressure drop of coil.

- b. Maximum pressure drops:
 - 1) Hot water at coils: 2 psi
 - 2) Chilled water coils: 5 psi
- D. Control Valve Actuators:
 - 1. Electronic Actuators: Direct-coupled type designed for minimum 60,000 full-stroke cycles at rated torque.
 - 2. Valves: Size for torque required for valve close off at maximum pump differential pressure.
 - 3. Coupling: V-bolt and V-shaped, toothed cradle.
 - 4. Overload Protection: Electronic overload or digital rotation-sensing circuitry.
 - 5. Fail-Safe Operation: Mechanical, spring-return mechanism. Provide external, manual gear release on non-spring-return actuators.
 - 6. Power Requirements (non-Spring Return): 24 V ac.
 - 7. Power Requirements (Modulating): Maximum 10 VA at 24-V ac or 8 W at 24-V dc.
 - 8. Proportional Signal: 2- to 10-V dc, and 2- to 10-V dc position feedback signal.
 - 9. Temperature Rating: 40 to 104 deg F
 - 10. Standard spring ranges are 2 to 5 psig, 3 to 10 psig, and 8 to 11 psig.
 - 11. Not pulse actuated.
- E. Wall Mount Room Temperature sensors:
 - 1. All room sensors shall be a combination temperature and humidity sensor and integrated CO₂ were shown on the floor plans.
 - 2. Sensor shall contain a backlit LCD digital display and user function keys along with temperature sensor. Controller shall function as room control unit, and shall allow occupant to raise and lower setpoint, and activate terminal unit for override use—all within limits as programmed by building operator. Sensor shall also allow service technician access to hidden functions as described in sequence of operation.
 - 3. The Intelligent Room Sensor shall simultaneously display room setpoint, room temperature, outside temperature, and fan status (if applicable) at each controller. This unit shall be programmable, allowing site developers the flexibility to configure the display to match their application. The site developer should be able to program the unit to display time-of-day, room humidity and outdoor humidity. Unit must have the capability to show temperatures in Fahrenheit or Centigrade.
 - 4. Override time may be set and viewed in half-hour increments. Override time count down shall be automatic but may be reset to zero by occupant from the sensor. Time remaining shall be displayed. Display shall show the word "OFF" in unoccupied mode unless a function button is pressed.
 - 5. See sequence of operation for specific operation of LCD displays and function keys in field service mode and in normal occupant mode. Provide intelligent room sensors as specified in point list.
 - 6. Field service mode shall be customizable to fit different applications. If intelligent room sensor is connected to terminal controller, terminal box shall be balanced, and all air flow parameters shall be viewed and set from the intelligent room sensor with no computer or other field service tool needed.
- F. Temperature Sensors:
 - 1. All temperature sensors to be solid state electronic, factory-calibrated to within 0.5°F, totally interchangeable with housing appropriate for application.
 - 2. Wall sensors to be installed as indicated on drawings. Mount 48 inches about finished floor.
 - 3. Duct sensors to be installed such that the sensing element is in the main air stream.
 - 4. Immersion sensors to be installed in wells provided by control contractor but installed by mechanical contractor. Immersion wells shall be filled with thermal compound before installation of immersion sensors.

5. Outside air sensors shall be installed away from exhaust or relief vents, not in an outside air intake and in a location that is in the shade most of the day.
- G. Humidity sensors shall be thin-film capacitive type sensor with on-board nonvolatile memory, accuracy to plus or minus two percent (2%) at 0 to 90% RH, 12 - 30 VDC input voltage, analog output (0 - 10 VDC or 4 - 20mA output). Operating range shall be 0 to 100% RH and 32 to 140 degrees F (0 to 60 degrees C). Sensors shall be selected for wall, duct or outdoor type installation as appropriate. Honeywell is basis of design.
- H. Carbon Dioxide Sensors (CO₂): Sensors shall utilize non-dispersive infrared technology (N.D.I.R.), repeatable to plus or minus 20 PPM. Sensor range shall be 0 - 2000 PPM. Accuracy shall be plus or minus five percent (5%) or 75 PPM, whichever is greater. Response shall be less than one minute. Input voltage shall be 20 to 30 VAC or DC. Output shall be 0 - 10 VDC. Sensor shall be wall or duct mounted type, as appropriate for the application, housed in a high impact plastic enclosure. Honeywell is basis of design.
- I. Current Sensitive Switches: Solid state, split core current switch that operates when the current level (sensed by the internal current transformer) exceeds the adjustable trip point. Current switch to include an integral LED for indication of trip condition and a current level below trip set point. Honeywell is basis of design.
- J. Differential Analog (duct) Static Pressure Transmitters Provide a pressure transmitter with integral capacitance type sensing and solid-state circuitry. Accuracy shall be plus or minus 1% of full range; range shall be selected for the specific application. Provide zero and span adjustment capability. Device shall have integral static pickup tube. Honeywell is basis of design.
- K. Differential Air Pressure Switches: Provide SPDT type, UL-approved, and selected for the appropriate operating range where applied. Switches shall have adjustable set points and barbed pressure tips. Honeywell is basis of design.
- L. Water Flow Switches: Provide a SPST type contact switch with bronze paddle blade, sized for the actual pipe size at the location. If installed outdoors, provide a NEMA-4 enclosure. Flow switch shall be UL listed.
- M. Temperature Control Panels: Furnish temperature control panels of code gauge steel with locking doors for mounting all devices as shown. All electrical devices within a control panel shall be factory wired. Control panel shall be assembled by the BMS in a UL-Certified 508A panel shop. A complete set of 'as-built' control drawings (relating to the controls within that panel) shall be furnished within each control panel.
- N. Pipe and Duct Temperature sensing elements: Accuracy of $\pm 1\%$. Their range shall be -5 to 250 degrees F (-20 to 121 degrees C). Limited range sensors shall be acceptable provided they are capable of sensing the range expected for the point at the specified accuracy. Thermal wells with heat conductive gel shall be included.
- O. Low Air Temperature Sensors: Provide SPST type switch, with 15 to 55 degrees F (-9 to 13 degrees C), range, vapor-charged temperature sensor.
- P. Variable Frequency Drives: The variable frequency drive (VFD) shall be designed specifically for use in Heating, Ventilation, and Air Conditioning (HVAC) applications in which speed control of the motor can be applied. The VFD, including all factory installed options, shall have UL & CSA approval. VFD's shall include communications capability with DDC BMS via built-in interface card (MODBUS or BACnet).
- Q. Relays: Start/stop relay model shall provide either momentary or maintained switching action

as appropriate for the motor being started. All relays shall be plugged in, interchangeable, mounted on a sub base and wired to numbered terminals strips. Relays installed in panels shall all be DPDT with indicating lamp. Relays installed outside of controlled devices shall be enclosed in a NEMA enclosure suitable for the location. Relays shall be labeled with UR symbol. RIB-style relays are acceptable for remote enable/disable.

- R. Emergency Stop Switches: Provide toggle-type switch with normally closed contact. Switch shall be labeled "AIR HANDLER EMERGENCY SHUTOFF, NORMAL - OFF."
- S. Transducers: Differential pressure transducers shall be electronic with a 4-20 mA output signal compatible to the Direct Digital Controller. Wetted parts shall be stainless steel. Unit shall be designed to operate in the pressure ranges involved.
- T. Control Power Transformers: Provide step-down transformers for all DDC controllers and devices as required. Transformers shall be sized for the load, but shall be sized for 50 watts, minimum. Transformers shall be UL listed Class 2 type, for 120 VAC/24 VAC operation.
- U. Line voltage protection: All DDC system control panels that are powered by 120 VAC circuits shall be provided with surge protection. This protection is in addition to any internal protection provided by the manufacturer. The protection shall meet UL, ULC 1449, IEEE C62.41B. A grounding conductor, (minimum 12 AWG), shall be brought to each control panel.

2.12 BAS SERVER & WEB BROWSER GUI - SYSTEM OVERVIEW

- A. The BAS Contractor shall provide system software based on server/thin-client architecture, designed around the open standards of web technology. The BAS server shall communicate using Ethernet and TCP. Server shall be accessed using a web browser over Owner intranet and remotely over the Internet.
- B. The intent of the thin-client architecture is to provide the operator(s) complete access to the BAS system via a web browser. The thin-client web browser Graphical User Interface (GUI) shall be browser and operating system agnostic, meaning it will support HTML5 enabled browsers without requiring proprietary operator interface and configuration programs or browser plug-ins. Microsoft, Firefox, and Chrome browsers (current released versions), and Windows as well as non-Windows operating systems.
- C. The BAS server software shall support at least the following server platforms (Windows 7, 8.1, Server 12). The BAS server software shall be developed and tested by the manufacturer of the system stand-alone controllers and network controllers/routers.
- D. The web browser GUI shall provide a completely interactive user interface and shall provide a HTML5 experience that supports the following features as a minimum:
 - 1. Trending.
 - 2. Scheduling.
 - 3. Electrical demand limiting.
 - 4. Duty Cycling.
 - 5. Downloading Memory to field devices.
 - 6. Real time 'live' Graphic Programs.
 - 7. Tree Navigation.
 - 8. Parameter changes of properties.
 - 9. Set point adjustments.
 - 10. Alarm / event information.
 - 11. Configuration of operators.
 - 12. Execution of global commands.
 - 13. Add, delete, and modify graphics and displayed data.

- E. Software Components: All software shall be the most current version. All software components of the BAS system software shall be provided and installed as part of this project. BAS software components shall include:
 - 1. Server Software, Database and Web Browser Graphical User Interface.
 - 2. 5 Year Software Maintenance license. Labor to implement not included.
 - 3. Embedded System Configuration Utilities for future modifications to the system and controllers.
 - 4. Embedded Graphical Programming Tools.
 - 5. Embedded Direct Digital Control software.
 - 6. Embedded Application Software.
- F. BAS Server Database: The BAS server software shall utilize a Java Database Connectivity (JDBC) compatible database such as: MS SQL 8.0, Oracle 8i or IBM DB2. BAS systems written to Non Standard and/or Proprietary databases are NOT acceptable.
- G. Thin Client - Web Browser Based: The GUI shall be thin client or browser based and shall meet the following criteria:
 - 1. Web Browser's for PC's: Only the current released browser (Explorer/Firefox/Chrome) will be required as the GUI and a valid connection to the server network. No installation of any custom software shall be required on the operator's GUI workstation/client. Connection shall be over an intranet or the Internet.
 - 2. Secure Socket Layers: Communication between the Web Browser GUI and BAS server shall offer encryption using 128-bit encryption technology within Secure Socket Layers (SSL). Communication protocol shall be Hyper-Text Transfer Protocol (HTTP).

2.13 WEB BROWSER GRAPHICAL USER INTERFACE

- A. Web Browser Navigation: The Thin Client web browser GUI shall provide a comprehensive user interface. Using a collection of web pages, it shall be constructed to "feel" like a single application and provide a complete and intuitive mouse/menu driven operator interface. It shall be possible to navigate through the system using a web browser to accomplish requirements of this specification. The Web Browser GUI shall (as a minimum) provide for navigation, and for display of animated graphics, schedules, alarms/events, live graphic programs, active graphic set point controls, configuration menus for operator access, reports and reporting actions for events.
- B. Login: On launching the web browser and selecting the appropriate domain name or IP address, the operator shall be presented with a login page that will require a login name and strong password. Navigation in the system shall be dependent on the operator's role-based application control privileges.
- C. Navigation: Navigation through the GUI shall be accomplished by clicking on the appropriate level of a navigation tree (consisting of an expandable and collapsible tree control like Microsoft's Explorer program) and/or by selecting dynamic links to other system graphics. Both the navigation tree and action pane shall be displayed simultaneously, enabling the operator to select a specific system or equipment and view the corresponding graphic. The navigation tree shall as a minimum provide the following views: Geographic, Network, Groups and Configuration.
 - 1. Geographic View shall display a logical geographic hierarchy of the system including cities, sites, buildings, building systems, floors, equipment, and objects.
 - 2. Groups View shall display Scheduled Groups and custom reports.
 - 3. Configuration View shall display all the configuration categories (Operators, Schedule, Event, Reporting and Roles).
- D. Action Pane: The Action Pane shall provide several functional views for each subsystem specified. A functional view shall be accessed by clicking on the corresponding button:

1. Graphics: Using graphical format suitable for display in a web browser, graphics shall include aerial building/campus views, color building floorplans, equipment drawings, active graphic set point controls, web content and other valid HTML elements. The data on each graphic page shall automatically refresh.
 2. Dashboards: User customizable data using drag and drop HTML5 elements. Shall include Web Charts, Gauges, and other custom developed widgets for web browser. User shall have ability to save custom dashboards.
 3. Search: User shall have multiple options for searching data based upon Tags. Associated equipment, real time data, Properties, and Trends shall be available in result.
 4. Properties: Shall include graphic controls and text for the following: Locking or overriding objects, demand strategies, and any other valid data required for setup. Changes made to the properties pages shall require the operator to depress an 'accept/cancel' button.
 5. Schedules: Shall be used to create, modify/edit and view schedules based on the systems hierarchy (using the navigation tree).
 6. Alarms: Shall be used to view alarm information geographically (using the navigation tree), acknowledge alarms, sort alarms by category, actions and verify reporting actions.
 7. Charting: Shall be used to display associated trend and historical data, modify colors, date range, axis and scaling. User shall have ability to create HTML charts through web browser without utilizing chart builder. User shall be able to drag and drop single or multiple data points, including schedules, and apply status colors for analysis.
 8. Logic - Live Graphic Programs: Shall be used to display 'live' graphic programs of the control algorithm, (micro block programming) for the mechanical/electrical system selected in the navigation tree.
 9. Other actions such as Print, Help, Command, and Logout shall be available via a drop-down window.
- E. Color Graphics: The Web Browser GUI shall make extensive use of color in the graphic pane to communicate information related to set points and comfort. Animated. gifs or .jpg, vector scalable, active set point graphic controls shall be used to enhance usability. Graphics tools used to create Web Browser graphics shall be non-proprietary and conform to the following basic criteria:
1. Display Size: The GUI workstation software shall graphically display in a minimum of 1024 by 768 pixels 24-bit True Color.
 2. General Graphic: General area maps shall show locations of controlled buildings in relation to local landmarks.
 3. Color Floor Plans: Floor plan graphics shall show heating and cooling zones throughout the buildings in a range of colors, as selected by Owner. Provide a visual display of temperature relative to their respective set points. The colors shall be updated dynamically as a zone's actual comfort condition changes.
 4. Mechanical Components: Mechanical system graphics shall show the type of mechanical system components serving any zone through the use of a pictorial representation of components. Selected I/O points being controlled or monitored for each piece of equipment shall be displayed with the appropriate engineering units. Animation shall be used for rotation or moving mechanical components to enhance usability. .
 5. Minimum System Color Graphics: Color graphics shall be selected and displayed via a web browser for the following:
 - a. Each piece of equipment monitored or controlled including each terminal unit.
 - b. Each building.
 - c. Each floor and zone controlled.
- F. Hierarchical Schedules: Utilizing the Navigation Tree displayed in the web browser GUI, an

operator (with proper access credentials) shall be able to define a Normal, Holiday or Override schedule for an individual piece of equipment or room or choose to apply a hierarchical schedule to the entire system, site or floor area. For example, Independence Day ' Holiday' for every level in the system would be created by clicking at the top of the geographic hierarchy defined in the Navigation Tree. No further operator intervention would be required and every control module in the system with would be automatically downloaded with the ' Independence Day' Holiday. All schedules that affect the system/area/equipment highlighted in the Navigation Tree shall be shown in a summary schedule table and graph.

1. Schedules: Schedules shall comply with the Lon Works and BACnet standards, (Schedule Object, Calendar Object, Weekly Schedule property and Exception Schedule property) and shall allow events to be scheduled based on:
 - a. Types of schedules shall be Normal, Holiday or Override.
 - b. A specific date.
 - c. A range of dates.
 - d. Any combination of Month of Year (1-12, any), Week of Month (1-5, last, any), Day of Week (M-Sun, Any).
 - e. Wildcard (example, allow combinations like second Tuesday of every month).
 2. Schedule Categories: The system shall allow operators to define and edit scheduling categories (different types of "things" to be scheduled; for example, lighting, HVAC occupancy, etc.). The categories shall include name, description, icon (to display in the hierarchy tree when icon option is selected) and type of value to be scheduled.
 3. Schedule Groups: In addition to hierarchical scheduling, operators shall be able to define functional Schedule Groups, comprised of an arbitrary group of areas/rooms/equipment scattered throughout the facility and site. For example, the operator shall be able to define an ' individual tenant' group - who may occupy different areas within a building or buildings. Schedules applied to the ' tenant group' shall automatically be downloaded to control modules affecting spaces occupied by the ' tenant group'.
 4. Intelligent Scheduling: The control system shall be intelligent enough to automatically turn on any supporting equipment needed to control the environment in an occupied space. If the operator schedules an individual room in a VAV system for occupancy, for example, the control logic shall automatically turn on the VAV air handling unit, chiller, boiler and/or any other equipment required to maintain the specified comfort and environmental conditions within the room.
 5. Partial Day Exceptions: Schedule events shall be able to accommodate a time range specified by the operator (ex: board meeting from 6 pm to 9 pm overrides Normal schedule for conference room).
 6. Schedule Summary Graph: The schedule summary graph shall clearly show Normal versus Holiday versus Override Schedules and the net operating schedule that results from all contributing schedules. Note: In case of priority conflict between schedules at the different geographic hierarchy, the schedule for the more detailed geographic level shall apply.
- G. Alarms: Alarms associated with a specific system, area, or equipment selected in the Navigation Tree, shall be displayed in the Action Pane by selecting an ' Alarms' view. Alarms, and reporting actions shall have the following capabilities:
1. Alarms View: Each Alarm shall display an Alarms Category (using a different icon for each alarm category), date/time of occurrence, current status, alarm report and a bold URL link to the associated graphic for the selected system, area or equipment. The URL link shall indicate the system location, address and other pertinent information. An operator shall easily be able to sort events, edit event templates and categories, acknowledge or force a return to normal in the Events View as specified in this section.
 2. Alarm Categories: The operator shall be able to create, edit or delete alarm categories such as HVAC, Maintenance, Fire, or Generator. An icon shall be associated with

- each alarm category, enabling the operator to easily sort through multiple events displayed.
3. Alarm Templates: Alarm template shall define different types of alarms and their associated properties. As a minimum, properties shall include a reference name, verbose description, severity of alarm, acknowledgement requirements, and high/low limit and out of range information.
 4. Alarm Areas: Alarm Areas enable an operator to assign specific Alarm Categories to specific Alarm Reporting Actions. For example, it shall be possible for an operator to assign all HVAC Maintenance Alarm on the 1st floor of a building to email the technician responsible for maintenance. The Navigation Tree shall be used to setup Alarm Areas in the Graphic Pane.
 5. Alarm Time/Date Stamp: All events shall be generated at the DDC control module level and comprise the Time/Date Stamp using the standalone control module time and date.
 6. Alarm Configuration: Operators shall be able to define the type of Alarm generated per object. A 'network' view of the Navigation Tree shall expose all objects and their respective Alarm Configuration. Configuration shall include assignment of Alarm, type of Acknowledgement and notification for return to normal or fault status.
 7. Alarm Summary Counter: The view of Alarm in the Graphic Pane shall provide a numeric counter, indicating how many Alarms are active (in alarm), require acknowledgement and total number of Alarms in the BAS Server database.
 8. Alarm Auto-Deletion: Alarms that are acknowledged and closed shall be auto-deleted from the database and archived to a text file after an operator defined period.
 9. Alarm Reporting Actions: Alarm Reporting Actions specified shall be automatically launched (under certain conditions) after an Alarm is received by the BAS server software. Operators shall be able to easily define these Reporting Actions using the Navigation Tree and Graphic Pane through the web browser GUI. Reporting Actions shall be as follows:
 - a. Print: Alarm information shall be printed to the BAS server's PC or a networked printer.
 - b. Email: Email shall be sent via any POP3-compatible e-mail server (most Internet Service Providers use POP3). Email messages may be copied to several email accounts. Note: Email reporting action shall also be used to support alphanumeric paging services, where email servers support pagers.
 - c. File Write: The ASCII File write reporting action shall enable the operator to append operator defined alarm information to any alarm through a text file. The alarm information that is written to the file shall be completely definable by the operator. The operator may enter text or attach other data point information (such as AHU discharge temperature and fan condition upon a high room temperature alarm).
 - d. Write Property: The write property reporting action updates a property value in a hardware module.
 - e. SNMP: The Simple Network Management Protocol (SNMP) reporting action sends an SNMP trap to a network in response to receiving an alarm.
 - f. Run External Program: The Run External Program reporting action launches specified program in response to an event.
- H. Trends: As system is engineered, all points shall be enabled to trend. Trends shall both be displayed and user configurable through the Web Browser GUI. Trends shall comprise analog, digital or calculated points simultaneously. A trend log's properties shall be editable using the Navigation Tree and Graphic Pane.
1. Viewing Trends: The operator shall have the ability to view trends by using the Navigation Tree and selecting a Trends button in the Graphic Pane. The system shall allow y- and x-axis maximum ranges to be specified and shall be able to display multiple trends simultaneously graphically per graph.

2. Local Trends: Trend data shall be collected locally by Multi-Equipment/Single Equipment general-purpose controllers, and periodically uploaded to the BAS server if historical trending is enabled for the object. Trend data, including run time hours and start time date shall be retained in non-volatile module memory. Systems that rely on a gateway/router to run trends are NOT acceptable.
 3. Resolution. Sample intervals shall be as small as one second. Each trended point will have the ability to be trended at a different trend interval. When multiple points are selected for displays that have different trend intervals, the system will automatically scale the axis.
 4. Dynamic Update. Trends shall be able to dynamically update at operator-defined intervals.
 5. Zoom/Pan. It shall be possible to zoom-in on a particular section of a trend for more detailed examination and 'pan through' historical data by simply scrolling the mouse.
 6. Numeric Value Display. It shall be possible to pick any sample on a trend and have the numerical value displayed.
 7. Copy/Paste. The operator shall have the ability to pan through a historical trend and copy the data viewed to the clipboard using standard keystrokes (i.e. CTRL+C, CTRL+V).
- I. Security Access: Systems that Security access from the web browser GUI to BAS server shall require a Login Name and Strong Password. Access to different areas of the BAS system shall be defined in terms of Role-Based Access Control privileges as specified:
1. Roles: Roles shall reflect the actual roles of different types of operators. Each role shall comprise a set of 'easily understood English language' privileges. Roles shall be defined in terms of View, Edit and Function Privileges.
 - a. View Privileges shall comprise: Navigation, Network, and Configuration Trees, Operators, Roles and Privileges, Alarm/Event Template and Reporting Action.
 - b. Edit Privileges shall comprise: Set point, Tuning and Logic, Manual Override, and Point Assignment Parameters.
 - c. Function Privileges shall comprise: Alarm/Event Acknowledgement, Control Module Memory Download, Upload, Schedules, Schedule Groups, Manual Commands, Print and Alarm/Event Maintenance.
 2. Geographic Assignment of Roles: Roles shall be geographically assigned using a similar expandable/collapsible navigation tree. For example, it shall be possible to assign two HVAC Technicians with similar competencies (and the same operator defined HVAC Role) to different areas of the system.

2.14 GRAPHICAL PROGRAMMING

- A. The system software shall include a Graphic Programming Language (GPL) for all DDC control algorithms resident in all control modules. Any system that does not use a drag and drop method of graphical icon programming shall not be accepted. All systems shall use a GPL method used to create a sequence of operations by assembling graphic microblocks that represent each of the commands or functions necessary to complete a control sequence. Microblocks represent common logical control devices used in conventional control systems, such as relays, switches, high signal selectors etc., in addition to the more complex DDC and energy management strategies such as PID loops and optimum start. Each microblock shall be interactive and contain the programming necessary to execute the function of the device it represents.
- B. Graphic programming shall be performed while on screen and using a mouse; each microblock shall be selected from a microblock library and assembled with other microblocks necessary to complete the specified sequence. Microblocks are then interconnected on screen using graphic "wires," each forming a logical connection. Once assembled, each logical grouping of microblocks and their interconnecting wires then forms a graphic function block which may be used to control any piece of equipment with a similar point configuration

and sequence of operation.

- C. **Graphic Sequence:** The clarity of the graphic sequence shall be such that the operator has the ability to verify that system programming meets the specifications, without having to learn or interpret a manufacturer's unique programming language. The graphic programming shall be self-documenting and provide the operator with an understandable and exact representation of each sequence of operation.
- D. **GPL Capabilities:** The following is a minimum definition of the capabilities of the Graphic Programming software:
 - 1. **Function Block (FB):** Shall be a collection of points, microblocks and wires which have been connected for the specific purpose of controlling a piece of HVAC equipment or a single mechanical system.
 - 2. **Logical I/O:** Input/Output points shall interface with the control modules to read various signals and/or values or to transmit signal or values to controlled devices.
 - 3. **Microblocks:** Shall be software devices that are represented graphically and may be connected to perform a specified sequence. A library of microblocks shall be submitted with the control contractors bid.
 - 4. **Wires:** Shall be Graphical elements used to form logical connections between microblocks and between logical I/O.
 - 5. **Reference Labels:** Labels shall be like wires in that they are used to form logical connections between two points. Labels shall form a connection by reference instead of a visual connection, i.e., two points labeled 'A' on a drawing are logically connected even though there is no wire between them.
 - 6. **Parameter:** A parameter shall be a value that may be tied to the input of a microblock.
 - 7. **Properties:** Dialog boxes shall appear after a microblock has been inserted which has editable parameters associated with it. Default parameter dialog boxes shall contain various editable and non-editable fields and shall contain 'push buttons' for the purpose of selecting default parameter settings.
 - 8. **Icon:** An icon shall be graphic representation of a software program. Each graphic microblock has an icon associated with it that graphically describes its function.
 - 9. **Menu-bar Icon:** Shall be an icon that is displayed on the menu bar on the GPL screen, which represents its associated graphic microblock.
 - 10. **Live Graphical Programs:** The Graphic Programming software shall support a 'live' mode, where all input/output data, calculated data and set points shall be displayed in a 'live' real-time mode.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. 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 GENERAL

- A. Install system and materials in accordance with manufacturer's instructions, and as detailed

on the project drawing set.

- B. Line and low voltage electrical connections to control equipment shown specified or shown on the control diagrams shall be furnished and installed by the Control System Contractor in accordance with these specifications.
- C. Equipment furnished by the Mechanical Contractor that is normally wired before installation shall be furnished completely wired. Control wiring normally performed in the field will be furnished and installed by the Control System Contractor.
- D. All control devices mounted on the face of control panels shall be clearly identified as to function and system served with permanently engraved phenolic labels.

3.4 WIRING

- A. All electrical control wiring to the control panels shall be the responsibility of the Control System Contractor.
- B. All wiring shall be in accordance with the Project Electrical Specifications (Division 16), the National Electrical Code and any applicable local codes. All control wiring shall be installed in raceways.
- C. Excess wire shall not be looped or coiled in the controller cabinet.
- D. Incorporate electrical noise suppression techniques in relay control circuits.
- E. There shall be no drilling on the controller cabinet after the controls are mounted inside.
- F. Careful stripping of wire while inside the cabinet is required to ensure that no wire strand fragments land on circuit boards.
- G. Use manufacturer-specified wire for all network connections.
- H. Use approved optical isolation and lightning protection when penetrating building envelope.
- I. Read installation instructions carefully. Any unavoidable deviations shall be approved by owner's rep prior to installation.

3.5 ACCEPTANCE TESTING

- A. Upon completion of the installation, the Control System Contractor shall load all system software and start-up the system. The Control System Contractor shall perform all necessary calibration, testing and de-bugging and perform all required operational checks to insure that the system is functioning in full accordance with these specifications.
- B. The Control System Contractor shall perform tests to verify proper performance of components, routines and points. Repeat tests until proper performance results. This testing shall include a point-by-point log to validate 100% of the input and output points of the DDC system operation.
- C. System Acceptance: Satisfactory completion is when the Control System Contractor has performed successfully all the required testing to show performance compliance with the requirements of the Contract Documents to the satisfaction of the Owner's Representative. System acceptance shall be contingent upon completion and review of all corrected deficiencies.

3.6 OPERATOR TRAINING

- A. During system commissioning and at such time acceptable performance of the Control System hardware and software has been established, the Control System Contractor shall provide on-site operator instruction to the owner's operating personnel. Operator instruction shall be done during normal working hours and shall be performed by a competent representative familiar with the system hardware, software, and accessories.
- B. The Control System Contractor shall provide 48 total hours of comprehensive training in multiple sessions for system orientation, product maintenance and troubleshooting, programming and engineering. These classes are to be spread out during the 1st year warranty period. The first class starting after final commissioning and the last class is to be in the last month of 1-year warranty period.

3.7 WARRANTY PERIOD SERVICES

- A. Equipment, materials, and workmanship incorporated into the work shall be warranted for a period of one year from the time of system acceptance.
- B. Within this period, upon notice by the Owner, any defects in the BMS due to faulty materials, methods of installation or workmanship shall be promptly repaired or replaced by the Control System Contractor at no expense to the Owner.
- C. Maintenance of Computer Software Programs: The Control System Contractor shall maintain all software during the standard first year warranty period. In addition, all factory or sub-vendor upgrades to software during the first-year warranty period shall be added to the systems, when they become available, at no additional cost. In addition to first year standard warranty, software provided by Control System Contractor shall come with a 5 Year Software Maintenance license. All SNC and BAS Servers are included in this coverage. Labor to implement upgrades in years two through five are not included in standard warranty.
- D. Maintenance of Control Hardware: The Control System Contractor shall inspect, repair, replace, adjust, and calibrate, as required, the controllers, control devices and associated peripheral units during the warranty period. The Control System Contractor shall then furnish a report describing the status of the equipment, problem areas (if any) noticed during service work, and description of the corrective actions taken. The report shall clearly certify that all hardware is functioning correctly.
- E. Service Period: Calls for service by the Owner shall be honored within 24 hours and are not to be considered as part of routine maintenance.
- F. Service Documentation: A copy of the service report associated with each owner-initiated service call shall be provided to the owner.

3.8 WARRANTY ACCESS

- A. The Owner shall grant to the Control System Contractor reasonable access to the BMS during the warranty period. Remote access to the BMS (for the purpose of diagnostics and troubleshooting, via the Internet, during the warranty period) will be allowed.

3.9 OPERATION & MAINTENANCE MANUALS

- A. See Division 1 for requirements. O&M manuals shall include the following elements, as a minimum:
 - 1. As-built control drawings for all equipment.
 - 2. As-built Network Communications Diagram.
 - 3. General description and specifications for all components.
 - 4. Completed Performance Verification sheets.

5. Completed Controller Checkout/Calibration Sheets.

3.10 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 232300 - REFRIGERANT PIPING

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. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

- A. Line Test Pressure for Refrigerant R-410A:
 - 1. Suction Lines for Air-Conditioning Applications: 300 psig.
 - 2. Suction Lines for Heat-Pump Applications: 535 psig.
 - 3. Hot-Gas and Liquid Lines: 535 psig.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
- B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
 - 1. Shop Drawing Scale: 1/4 inch equals 1 foot.
 - 2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.7 QUALITY ASSURANCE

- A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."
- C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.8 PRODUCT STORAGE AND HANDLING

- A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.9 COORDINATION

- A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

- A. Copper Tube: ASTM B 88, Type K.
- B. Wrought-Copper Fittings: ASME B16.22.
- C. Wrought-Copper Unions: ASME B16.22.
- D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.
- E. Brazing Filler Metals: AWS A5.8.
- F. Flexible Connectors:
 - 1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
 - 2. End Connections: Socket ends.
 - 3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
 - 4. Pressure Rating: Factory test at minimum 500 psig.
 - 5. Maximum Operating Temperature: 250 deg F.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-410A

- A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.
- B. Hot-Gas and Liquid Lines, and Suction Lines for Heat-Pump Applications: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- B. Install refrigerant piping according to ASHRAE 15.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping adjacent to machines to allow service and maintenance.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Select system components with pressure rating equal to or greater than system operating pressure.
- J. Refer to Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence of Operations for HVAC Controls" for solenoid valve controllers, control wiring, and sequence of operation.
- K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.
- L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Section 083113 "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.
- M. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

N. Slope refrigerant piping as follows:

1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

O. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Identify refrigerant piping and valves according to Section 230553 "Identification for HVAC Piping and Equipment."

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 230517 "Sleeves and Sleeve Seals for HVAC Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 230518 "Escutcheons for HVAC Piping."

3.3 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

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

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."

1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.

3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.

2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
 - a. Fill system with nitrogen to the required test pressure.
 - b. System shall maintain test pressure at the manifold gage throughout duration of test.
 - c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
 - d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

END OF SECTION 23 2300

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
 - 2. Single-wall round ducts and fittings.
 - 3. Sheet metal materials.
 - 4. Duct liner.
 - 5. Sealants and gaskets.
 - 6. Hangers and supports.

- B. Related Sections:

- 1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
 - 2. Section 233300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports and seismic restraints shall withstand the effects of gravity and seismic loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and ASCE/SEI 7. SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of the following products:

- 1. Liners and adhesives.
 - 2. Sealants and gaskets.

3. Seismic-restraint devices.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, seismic restraints, and vibration isolation.

C. Delegated-Design Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation for selecting hangers and supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Perimeter moldings.

B. Welding certificates.

- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 - 2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.
 - 3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
 - 2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
- D. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Aluminum Sheets: Comply with ASTM B 209 Alloy 3003, H14 temper; with mill finish for concealed ducts, and standard, one-side bright finish for duct surfaces exposed to view.
- D. Factory- or Shop-Applied Antimicrobial Coating:
 - 1. Apply to the surface of sheet metal that will form the interior surface of the duct. An untreated clear coating shall be applied to the exterior surface.
 - 2. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.
 - 3. Coating containing the antimicrobial compound shall have a hardness of 2H, minimum, when tested according to ASTM D 3363.
 - 4. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
 - 5. Antimicrobial coating on sheet metal is not required for duct containing liner treated with antimicrobial coating.
- E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
 - 1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

- F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

- A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. CertainTeed Corporation.
- b. Johns Manville; a Berkshire Hathaway company.
- c. Knauf Insulation.
- d. Owens Corning.
 - 1) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.

2. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.

- a. 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).
- b. 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."

- B. Insulation Pins and Washers:

1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick stainless steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

- C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 7-11, "Flexible Duct Liner Installation."

1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
3. Butt transverse joints without gaps, and coat joint with adhesive.
4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.

5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
6. Apply adhesive coating on longitudinal seams in ducts with air velocity of 2500 fpm.
7. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
8. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
 - a. Fan discharges.
 - b. Intervals of lined duct preceding unlined duct.
 - c. Upstream edges of transverse joints in ducts where air velocities are higher than 2500 fpm or where indicated.
9. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
 - a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area of 23 percent.
10. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two-Part Tape Sealing System:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
 2. Tape Width: 4 inches.
 3. Sealant: Modified styrene acrylic.
 4. Water resistant.
 5. Mold and mildew resistant.
 6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
 7. Service: Indoor and outdoor.
 8. Service Temperature: Minus 40 to plus 200 deg F.
 9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
 10. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 11. Sealant 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. Water-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Solids Content: Minimum 65 percent.
3. Shore A Hardness: Minimum 20.
4. Water resistant.
5. Mold and mildew resistant.
6. VOC: Maximum 75 g/L (less water).
7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
8. Service: Indoor or outdoor.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
7. Sealant 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. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

C. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

D. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

- F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- G. Trapeze and Riser Supports:
 - 1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

2.7 SEISMIC-RESTRAINT DEVICES

- A. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.
 - 1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.
- B. Channel Support System: Shop- or field-fabricated support assembly made of slotted steel channels rated in tension, compression, and torsion forces and with accessories for attachment to braced component at one end and to building structure at the other end. Include matching components and corrosion-resistant coating.
- C. Restraint Cables: ASTM A 603, galvanized-steel cables with end connections made of cadmium-plated steel assemblies with brackets, swivel, and bolts designed for restraining cable service; and with an automatic-locking and clamping device or double-cable clips.
- D. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections to hanger rod.
- E. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in maximum practical lengths.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.
- J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.
- L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.
- C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
 - 1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
4. Unconditioned Space, Exhaust Ducts: Seal Class C.
5. Unconditioned Space, Return-Air Ducts: Seal Class B.
6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
8. Conditioned Space, Exhaust Ducts: Seal Class B.
9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
 1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.
- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 SEISMIC-RESTRAINT-DEVICE INSTALLATION

- A. Install ducts with hangers and braces designed to support the duct and to restrain against seismic forces required by applicable building codes. Comply with SMACNA's "Seismic Restraint Manual: Guidelines for Mechanical Systems." ASCE/SEI 7.

1. Space lateral supports a maximum of 40 feet o.c., and longitudinal supports a maximum of 80 feet o.c.
 2. Brace a change of direction longer than 12 feet.
- B. Select seismic-restraint devices with capacities adequate to carry present and future static and seismic loads.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install cable restraints on ducts that are suspended with vibration isolators.
- E. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction.
- F. Attachment to Structure: If specific attachment is not indicated, anchor bracing and restraints to structure, to flanges of beams, to upper truss chords of bar joists, or to concrete members.
- G. Drilling for and Setting Anchors:
1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcement or embedded items during drilling. Notify the Architect if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 4. Set anchors to manufacturer's recommended torque, using a torque wrench.
 5. Install zinc-coated steel anchors for interior applications and stainless-steel anchors for applications exposed to weather.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 233300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:
 - 1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 - 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - e. Outdoor Air Ducts: Test representative duct sections totaling no less than 100 percent of total installed duct area for each designated pressure class.
 - 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 - 4. Test for leaks before applying external insulation.
 - 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 - 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
 - 1. Visually inspect duct system to ensure that no visible contaminants are present.
 - 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

3.9 DUCT CLEANING

- A. Clean new duct system(s) before testing, adjusting, and balancing.
- B. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch

- insulation and liner as recommended by duct liner manufacturer. Comply with Section 233300 "Air Duct Accessories" for access panels and doors.
- 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
- 3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

- 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
- 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

- 1. Air outlets and inlets (registers, grilles, and diffusers).
- 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
- 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
- 4. Coils and related components.
- 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
- 6. Supply-air ducts, dampers, actuators, and turning vanes.
- 7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

- 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
- 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
- 3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
- 4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
- 5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
- 6. Provide drainage and cleanup for wash-down procedures.
- 7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

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. Backdraft and pressure relief dampers.
 - 2. Barometric relief dampers.
 - 3. Manual volume dampers.
 - 4. Control dampers.
 - 5. Combination fire and smoke dampers.
 - 6. Flange connectors.
 - 7. Turning vanes.
 - 8. Remote damper operators.
 - 9. Duct-mounted access doors.
 - 10. Flexible connectors.
 - 11. Flexible ducts.
 - 12. Duct accessory hardware.
 - 13. Section 283111 "Digital, Addressable Fire-Alarm System" for duct-mounted fire and smoke detectors.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.
- B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.
- B. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.
- C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.
- D. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Nailor Industries Inc.
 2. Pottorff.
 3. Ruskin Company.
 4. Vent Products Co., Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2000 fpm.
- D. Maximum System Pressure: 2-inch wg.
- E. Frame: Hat-shaped, 0.063-inch- thick extruded aluminum, with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, center pivoted, maximum 6-inch-width, 0.025-inch-thick, roll-formed aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Neoprene, mechanically locked.
- I. Blade Axles:
1. Material: Nonferrous metal.
 2. Diameter: 0.20 inch.
- J. Tie Bars and Brackets: Aluminum.
- K. Return Spring: Adjustable tension.
- L. Bearings: Steel ball.
- M. Accessories:
1. Adjustment device to permit setting for varying differential static pressure.
 2. Counterweights and spring-assist kits for vertical airflow installations.
 3. Electric actuators.
 4. Chain pulls.
 5. Screen Mounting: Front mounted in sleeve.
 - a. Sleeve Thickness: 20 gage minimum.
 - b. Sleeve Length: 6 inches minimum.
 6. Screen Mounting: Rear mounted.
 7. Screen Material: Aluminum.
 8. Screen Type: Insect.
 9. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Flexmaster U.S.A., Inc.
 - b. McGill AirFlow LLC.
 - c. Nailor Industries Inc.
 - d. Pottorff.
 - e. Ruskin Company.
 - f. Vent Products Co., Inc.
2. Standard leakage rating, with linkage outside airstream.
3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 0.064 inch thick.
6. Blade Axles: Galvanized steel.
7. Bearings:
 - a. Oil-impregnated bronze.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
8. Tie Bars and Brackets: Galvanized steel.

2.5 CONTROL DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. McGill AirFlow LLC.
2. Nailor Industries Inc.
3. Pottorff.
4. Ruskin Company.
5. Vent Products Co., Inc.
6. Young Regulator Company.

B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.

C. Frames:

1. Hat shaped.
2. 0.094-inch-thick, galvanized sheet steel.
3. Mitered and welded corners.

D. Blades:

1. Multiple blade with maximum blade width of 6 inches.
2. Parallel- and opposed-blade design.
3. Galvanized-steel.
4. 0.0747-inch-thick dual skin.
5. Blade Edging: Closed-cell neoprene.
6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.

E. Blade Axles: 1/2-inch-diameter; stainless steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.

1. Operating Temperature Range: From minus 40 to plus 200 deg F.

F. Bearings:

1. Oil-impregnated bronze.
2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
3. Thrust bearings at each end of every blade.

2.6 COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Nailor Industries Inc.
2. Pottorff.
3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 and UL 555S by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 1-1/2 hours.

E. Frame: Hat-shaped, 0.094-inch-thick, galvanized sheet steel, with welded interlocking, gusseted or mechanically attached corners and mounting flange.

F. Heat-Responsive Device: Resettable, 165 deg F rated, fire-closure device.

G. Heat-Responsive Device: Electric resettable device and switch package, factory installed, rated.

H. Smoke Detector: Integral, factory wired for single-point connection.

I. Blades: Roll-formed, horizontal, interlocking, 0.063-inch-thick, galvanized sheet steel.

J. Leakage: Class I.

- K. Rated pressure and velocity to exceed design airflow conditions.
- L. Mounting Sleeve: Factory-installed, 0.05-inch-thick, galvanized sheet steel; length to suit wall or floor application with factory-furnished silicone calking.
- M. Master control panel for use in dynamic smoke-management systems.
- N. Damper Motors: two-position action.
- O. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - 1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.
 - 2. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
 - 3. Permanent-Split-Capacitor or Shaded-Pole Motors: With oil-immersed and sealed gear trains.
 - 4. Spring-Return Motors: Equip with an integral spiral-spring mechanism where indicated. Enclose entire spring mechanism in a removable housing designed for service or adjustments. Size for running torque rating of 150 in. x lbf and breakaway torque rating of 150 in. x lbf.
 - 5. Outdoor Motors and Motors in Outdoor-Air Intakes: Equip with O-ring gaskets designed to make motors weatherproof. Equip motors with internal heaters to permit normal operation at minus 40 deg F.
 - 6. Nonspring-Return Motors: For dampers larger than 25 sq. ft., size motor for running torque rating of 150 in. x lbf and breakaway torque rating of 300 in. x lbf.
 - 7. Electrical Connection: 115 V, single phase, 60 Hz.
- P. Accessories:
 - 1. Auxiliary switches for signaling or position indication.
 - 2. Test and reset switches, remote mounted.

2.7 FLANGE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CL WARD & Family Inc.
 - 2. Ductmate Industries, Inc.
 - 3. Hardcast, Inc.
 - 4. Nexus PDQ.
 - 5. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.
- C. Material: Galvanized steel.
- D. Gage and Shape: Match connecting ductwork.

2.8 TURNING VANES

- A. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
 - 1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.
- B. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
- C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."
- D. Vane Construction: Single or Double wall as applicable.
- E. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.9 REMOTE DAMPER OPERATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Pottorff.
 - 2. Ventfabrics, Inc.
 - 3. Young Regulator Company.
- B. Description: Cable system designed for remote manual damper adjustment.
- C. Tubing: Aluminum.
- D. Cable: Steel.
- E. Wall-Box Mounting: Recessed.
- F. Wall-Box Cover-Plate Material: Stainless steel.

2.10 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ductmate Industries, Inc.
 - 2. Flexmaster U.S.A., Inc.
 - 3. McGill AirFlow LLC.
 - 4. Nailor Industries Inc.
 - 5. Pottorff.
 - 6. Ventfabrics, Inc.

- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2 (7-2M), "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Continuous and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Continuous and two compression latches with outside and inside handles.

2.11 DUCT ACCESS PANEL ASSEMBLIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. 3M.
 2. Ductmate Industries, Inc.
 3. Flame Gard, Inc.
- B. Labeled according to UL 1978 by an NRTL.
- C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.
- D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.
- E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.
- F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.12 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Ductmate Industries, Inc.
 2. Hardcast, Inc.
 3. Ventfabrics, Inc.
 4. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.

- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
 - 1. Minimum Weight: 26 oz./sq. yd..
 - 2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
 - 3. Service Temperature: Minus 40 to plus 200 deg F.
 - 4. .

2.13 FLEXIBLE DUCTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexmaster U.S.A., Inc.
 - 2. Flex-Tek Group.
 - 3. McGill AirFlow LLC.
 - 4. Ward Industries; a brand of Hart & Cooley, Inc.
- B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
 - 1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
 - 2. Maximum Air Velocity: 4000 fpm.
 - 3. Temperature Range: Minus 10 to plus 160 deg F.
 - 4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.
- C. Flexible Duct Connectors:
 - 1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.14 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
 - 1. Install steel volume dampers in steel ducts.
 - 2. Install aluminum volume dampers in aluminum ducts.
- E. Set dampers to fully open position before testing, adjusting, and balancing.
- F. Install test holes at fan inlets and outlets and elsewhere as indicated.
- G. Install fire/smoke dampers according to UL listing.
- H. Connect ducts to duct silencers rigidly.
- I. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
 - 1. At outdoor-air intakes and mixed-air plenums.
 - 2. At drain pans and seals.
 - 3. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 - 4. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
 - 5. At each change in direction and at maximum 50-foot spacing.
 - 6. Upstream from turning vanes.
 - 7. Upstream or downstream from duct silencers.
 - 8. Control devices requiring inspection.
 - 9. Elsewhere as indicated.
- J. Install access doors with swing against duct static pressure.
- K. Access Door Sizes:
 - 1. One-Hand or Inspection Access: 8 by 5 inches.
 - 2. Two-Hand Access: 12 by 6 inches.
 - 3. Head and Hand Access: 18 by 10 inches.
 - 4. Head and Shoulders Access: 21 by 14 inches.
 - 5. Body Access: 25 by 14 inches.
 - 6. Body plus Ladder Access: 25 by 17 inches.
- L. Label access doors according to Section 230553 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

- M. Install flexible connectors to connect ducts to equipment.
- N. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.
- O. Connect terminal units to supply ducts directly. Do not use flexible ducts to change directions.
- P. Connect diffusers to ducts directly or with maximum 60-inch lengths of flexible duct clamped or strapped in place.
- Q. Connect flexible ducts to metal ducts with draw bands.
- R. Install duct test holes where required for testing and balancing purposes.
- S. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Operate dampers to verify full range of movement.
 - 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 - 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 - 4. Inspect turning vanes for proper and secure installation.
 - 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS, AND GRILLES

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. Modular core supply air diffusers.
 - 2. Fixed face registers and grilles.
- B. Related Sections:
 - 1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
 - 1. Ceiling suspension assembly members.
 - 2. Method of attaching hangers to building structure.
 - 3. Size and location of initial access modules for acoustical tile.
 - 4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 5. Duct access panels.
- B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

- A. Modular Core Diffusers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Titus
 - b. Price.
 - c. Krueger.
2. Material: Steel.
3. Finish: White baked acrylic.
4. Border: 1-1/2-inch-width with countersunk screw holes.
5. Blades:
 - a. Set in modules.
6. Modules: Removable; rotatable.
7. Mounting: Surface.

2.2 REGISTERS AND GRILLES

A. Fixed Face Grille:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Titus
 - b. Price.
 - c. Krueger.
2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Core Construction: Integral.
5. Frame: 1 inch wide.
6. Mounting: Countersunk screw or Concealed.

2.3 SOURCE QUALITY CONTROL

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONERS

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 split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Wiring Diagrams: For power, signal, and control wiring.
- C. Samples for Initial Selection: For units with factory-applied color finishes.

1.4 INFORMATIONAL SUBMITTALS

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

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One set(s) for each air-handling unit.
2. Gaskets: One set(s) for each access door.

1.7 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- B. ASHRAE Compliance:
 1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
 2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.8 COORDINATION

- A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Section 033000 "Cast-in-Place Concrete."
- B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.9 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 1. Warranty Period:
 - a. For Compressor: Five year(s) from date of Substantial Completion.
 - b. For Parts: One year(s) from date of Substantial Completion.
 - c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Carrier
 2. LG
 3. Daikin
 4. Mitsubishi Electric & Electronics USA, Inc.

2.2 INDOOR UNITS

A. Concealed Evaporator-Fan Components:

1. Chassis: Galvanized steel with flanged edges, removable panels for servicing, and insulation on back of panel.
2. Insulation: Faced, glass-fiber duct liner.
3. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
4. Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch; leak tested to 300 psig underwater; with a two-position control valve.
5. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
6. Fan: Forward-curved, double-width wheel of galvanized steel; directly connected to motor.
7. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Wiring Terminations: Connect motor to chassis wiring with plug connection.
8. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
9. Filters: Permanent, cleanable.
10. Condensate Drain Pans:
 - a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 2 inches deep.
 - b. Stainless-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
 - e. Units with stacked coils shall have an intermediate drain pan to collect condensate from top coil.

B. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
3. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements; with refractory ceramic support bushings, automatic-reset thermal cutout, built-in magnetic contactors, manual-reset thermal cutout, airflow proving device, and one-time fuses in terminal box for overcurrent protection.
4. Fan: Direct drive, centrifugal.
5. Fan Motors:
 - a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment."
 - b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
 - c. Enclosure Type: Totally enclosed, fan cooled.
 - d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
 - e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
 - f. Mount unit-mounted disconnect switches on exterior of unit.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
 - a. Fabricated with two percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
 - 1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
 - 2) Depth: A minimum of 1 inch deep.
 - b. Stainless-steel sheet.
 - c. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
 - 1) Minimum Connection Size: NPS 1.
 - d. Pan-Top Surface Coating: Asphaltic waterproofing compound.
8. Air Filtration Section:
 - a. General Requirements for Air Filtration Section:
 - 1) Comply with NFPA 90A.
 - 2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
 - 3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.
 - b. Disposable Panel Filters:

- 1) Factory-fabricated, viscous-coated, flat-panel type.
- 2) Thickness: 1 inch.
- 3) Merv according to ASHRAE 52.2: 8.
- 4) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
- 5) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

2.3 OUTDOOR UNITS

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - a. Compressor Type: Scroll.
 - b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - c. Refrigerant Charge: R-410A.
 - d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.
3. Heat-Pump Components: Reversing valve and low-temperature-air cutoff thermostat.
4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 0 deg F.
7. Mounting Base: Polyethylene.

2.4 ACCESSORIES

- A. Control equipment and sequence of operation are specified in Section 230900 "Instrumentation and Control for HVAC" and Section 230993 "Sequence and Operations for HVAC Controls."
- B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
- C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
 1. Compressor time delay.
 2. 24-hour time control of system stop and start.
 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 4. Fan-speed selection including auto setting.
- D. Automatic-reset timer to prevent rapid cycling of compressor.
- E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

- F. Drain Hose: For condensate.
- G. Additional Monitoring:
 - 1. Monitor motor loads.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 077200 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.
- D. Equipment Mounting:
 - 1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 - 2. Install ground-mounted, compressor-condenser components on a mounting base.
 - 3. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."
 - 4. Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."
- E. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Where piping is installed adjacent to unit, allow space for service and maintenance of unit.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.5 DEMONSTRATION

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

END OF SECTION 23 8126

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

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. This Section covers and applies to all work specified in Division 26 (and 27 & 28).
- B. Work Included: Materials, equipment, fabrication, installation and tests for fully operational and safe systems, including all necessary materials, appurtenances and features whether specified or shown on drawings or not, in conformity with applicable codes and authorities having jurisdiction for the following:
 - 1. Electrical work specified in all sections within Division 26 (and 27 & 28) of these specifications, including, but not limited to:
 - a. Short circuit analysis.
 - b. Primary underground service ducts from the point of connection to the Serving Agency to the transformer vault, building main switchboard.
 - c. Equipment for serving agency facilities shall be furnished and installed in accordance with the requirements of the Serving Utility. Transformers, primary cable, and utilization equipment will be furnished and installed by the Serving Agency.
 - d. Lighting and power distribution facilities, including busways, main switchboard with metering, transformers, distribution boards, panelboards with feeders, motor control centers, branch circuit wiring, connections to outlets, and wiring devices.
 - e. Lighting fixtures and lamps.
 - f. Motor and other power-consuming equipment connections from motor control centers or distribution apparatus to equipment.
 - g. Telephone and Data conduit system, including underground service facilities, riser and lateral extension conduits, and facilities required in terminal room in accordance with the requirements of the Telephone Utility.
 - h. Control, alarm and interlock wiring for mechanical equipment, where indicated.
 - i. Electrical grounding system.
 - j. Emergency power and lighting system, including engine-generator set complete with oil system and power transfer capability.
 - k. Vibration and seismic controls for electrical systems.
 - l. Life safety system including ADA requirements.
 - m. Cable tray system.
 - n. Low voltage system (PA, CATV, Security, etc.)

- o. Excavation, backfilling and compacting for the Electrical Work.
- p. Cutting and patching for the Electrical Work.
- q. Adjustment and testing of the Electrical Work.
- r. Examine the drawings and specifications of other Divisions and provide electrical service for all equipment, devices and controls noted therein, unless work specifically is not included.
- s. Lighting control system.
- t. Dimming system.
- u. Underfloor power and telephone/telecom distribution system.

1.3 DESCRIPTION OF BID DOCUMENTS

A. Specifications:

- 1. Specifications, in general, describe quality and character of materials and equipment.
- 2. Specifications are of simplified form and include incomplete sentences.
- 3. Words or phrases such as "The Contractor shall," "shall be," "furnish," provide," "a," "an," "the," and "all" etc. have been omitted for brevity.

B. Drawings:

- 1. Electrical layouts are generally diagrammatic and, although size and location of equipment is drawn to scale wherever possible, Contractor shall make use of all data in Contract Documents and verify this information at building site.
- 2. Locations of items on the drawings may be distorted for purposes of clearness and legibility. Actual locations of architectural and mechanical items are shown on architectural and mechanical drawings.
- 3. Contractor shall adjust locations of light fixtures in mechanical rooms to compensate for changes in duct routing, to provide reasonably uniform lighting in work areas.
- 4. Outlets shall be located in accordance with architectural design, and specific locations may be determined by Owner's representative at jobsite prior to installation.
- 5. Outlets located on architectural plans by dimension shall be held. Additional outlets may be shown on electrical plans and shall be installed as close as practical to the location shown.
- 6. Manufacturers' drawings and instructions shall be followed in all cases where the makers of devices and equipment furnish directions, where details are not shown on the drawings, or where described in the specifications.
- 7. Work installed in a manner contrary to that shown in the contract documents shall be removed and reinstalled when so directed by the Architect. Discrepancies and questionable points shall be immediately reported to the Architect for clarification.
- 8. The Owner and the Architect reserve the right to make reasonable changes in outlet locations in each area prior to roughing-in at no additional cost to the Owner.

C. If any part of specifications or drawings appears unclear or contradictory, apply to Architect for his interpretation and decision as early as possible, including during bidding period. Do not proceed with such work without Architect's decision.

1.4 JOB CONDITIONS

- A. Examine all drawings and specifications in a manner to be fully cognizant of all work required under this Division.
- B. Adjoining work of other Divisions shall be examined for interferences and conditions affecting this Division.
- C. Examine site related work and surfaces before starting work of any Section.
 - 1. Report to Architect, in writing, conditions which will prevent proper provision of this work.
 - 2. Beginning work of any Section without reporting unsuitable conditions to Architect constitutes acceptance of conditions by Contractor.
 - 3. Perform any required removal, repair or replacement of this work caused by unsuitable conditions at no additional cost to Owner.
- D. Connections to existing work:
 - 1. Verification of existing: Before submitting bid, become thoroughly familiar with actual existing conditions and systems at the building, and of the existing installations to which connections must be made, including any necessary alterations, and existing building engineering practices and requirements. The intent of the work is shown on the drawings and described herein, and no consideration will be granted by reason of lack of familiarity on the part of the contractor with actual physical conditions, requirements, and practices at the site.
 - 2. Install new work and connect to existing work with minimum interference to existing facilities.
 - 3. Temporary shutdowns of existing services: At times not to interfere with normal operation of existing facilities and only with written approval of the Owner, at no additional charges.
 - 4. Maintain continuous operation of existing facilities as required with necessary temporary connections between new and existing work. Do not interrupt alarm and emergency systems.
 - 5. Connect new work to existing work in neat and acceptable manner. Restore existing disturbed work to original condition including maintenance of wiring continuity as required.
 - 6. Following work shall be performed only after regular working hours:
 - a. Power interruption
 - b. High Noise level work
 - c. X-ray of concrete for coring location verification
- E. Removal and Relocation of Existing Work:
 - 1. Disconnect, remove or relocate electrical material, equipment and other work noted and required by removal or changes in existing construction.
 - 2. Provide new material and equipment required for relocated equipment.
 - 3. Disconnect load and supply end of conductors feeding existing equipment.
 - 4. Remove conductors from existing raceways to be rewired.
 - 5. Tape both ends of abandoned conductors. Cap outlets and abandoned raceways.
 - 6. Cut and cap abandoned floor raceways flush with concrete floor or behind walls and ceilings.

- 7. Dispose of removed raceways and wire.
- 8. Dispose of removed electrical equipment as directed.

- F. If asbestos insulation is found when working in existing areas, immediately stop work and notify Architect. Do not restart work until advised in writing by Architect that it is safe to do so following abatement, encapsulation, etc.

1.5 DEFINITIONS

- A. "Provide": To furnish, install and connect complete and ready for safe and regular operation of particular work referred to unless specifically otherwise noted.
- B. "Install": To erect, mount and connect complete with related accessories.
- C. "Furnish" or "Supply": To purchase, procure, acquire and deliver complete with related accessories.
- D. "Work": Labor, materials, equipment, apparatus, controls, accessories and other items required for proper and complete installation.
- E. "Wiring": Raceway, fittings, wire, boxes and related items.
- F. "Concealed": Embedded in masonry or other construction, installed in furred spaces, within double partitions or hung ceilings, in trenches, in crawl spaces or in enclosures.
- G. "Exposed": Not installed underground or "concealed" as defined above.
- H. "Indicated" "Shown" or "Noted": As indicated, shown or noted on drawings or specifications.
- I. "Equal": Equal in quality, workmanship, materials, weight, size, design and efficiency of specified product, conforming with "Manufacturers".
- J. "Reviewed," "Satisfactory," "Accepted," or "Directed": As reviewed, satisfactory, accepted or directed by or to Architect.
- K. "Motor Controllers": Manual or magnetic starters (with or without switches), individual pushbuttons, or hand-off-automatic (HOA) switches controlling the operation of motors.
- L. "Control Devices": Automatic sensing and switching devices such as thermostats, pressure, float, electro-pneumatic switches and electrodes controlling operation of equipment.

1.6 UTILITY CONNECTIONS

- A. Finalize electrical service arrangements including verification of locations and details with the Serving Agency.
- B. Verify locations of facilities and details with the Telephone Utility.

1. Final telephone service arrangements will be made by the Owner.
- C. In addition to the requirements shown on the drawings and stated herein, the work shall comply with the following:
 1. Construction Standards and Service Requirements of the respective utilities including any supplementary drawings issued by the utilities.
 2. Be subjected to inspection approval of these utilities.
- D. Electrical service facilities shall consist of furnishing and installing concrete encased primary conduits, transformer vault appurtenances and secondary service including utility meter in accordance with the arrangement, details, and locations shown on the drawings and described herein and as required by the utility company.
 1. Transformer vault: Furnish and install conduits and ducts with terminations, mounting inserts, lighting fixtures and wiring devices, conduits with outlets, wire with connections for lighting facilities, grounding conductors and fittings and other work as required by the Serving Agency.

1.7 ELECTRICAL SYSTEM CHARACTERISTICS

- A. Service: 480/277 volts, 3 phase, 4 wire with grounded neutral.
- B. LED Lighting: 120 volts.
- C. Motors \square horsepower and above: 480 volts, 3 phase.
- D. Fractional horsepower motors less than \square horsepower: 120 volts single phase.
- E. General receptacles will be supplied at 120 volts.

1.8 MOUNTING HEIGHTS

- A. Mounting heights of devices and equipment shown on the architectural drawings shall govern, but in the absence of such indications, the following centerline heights above the finished floor shall be maintained.

- | | | |
|----|-------------------------------------|--|
| 1. | Wall switches | 3 feet - 6 inches (or as directed by architect). |
| 2. | Wall lights (interior) | 7 feet - 0 inches (or as directed by architect). |
| 3. | Pendant or chain hung fixture | 10 feet - 0 inches (or as directed by architect). |
| 4. | Convenience receptacles | 1 foot - 3 inches except in Toilets and over cabinets or -counters where devices shall be mounted at 4 feet - 0 inches (9 inches above counter). |
| 5. | Fire alarm stations | 4 feet - 0 inches. |
| 6. | Telephone and communication outlets | 1 foot - 3 inches. |
| 7. | Clock outlets | 1 foot - 6 inches below finished ceiling. |
| 8. | Panelboard cabinets | Shall be installed with the top 6 feet - 6 inches above the floor for cabinets more than 2 feet - 6 inches high and 6 feet - 0 inches for cabinets less than 2 feet - 6 inches high. |
| 9. | Motor controllers | 5 feet-0 inches. |

1.9 SUBMITTALS

- A. Submit shop drawings, product data, samples and certificates of compliance required by contract documents.
 - 1. See Submittals paragraph in Division 1.
- B. Submit no later than 30 days after signing of Contract:
 - 1. Complete schedule of submittals for equipment and layout shop drawings.
 - 2. Submittals schedule shall be in such sequence as to cause no delay in work or in work of any other division.
- C. Corrections or comments made on the shop drawings during review do not relieve the Contractor from compliance with requirements of the drawings and specifications. Shop drawing checking by the Engineer is only for review of general conformance with the design concept of the project and general compliance with the information given in the contract documents. The Contractor is responsible for:

1. Confirming and correlating all quantities and dimensions.
2. Fabrication processes and techniques of construction.
3. Work with all other trades.
4. Work in a safe and satisfactory manner.
5. Equipment that can be installed in the available space with all code clearances, prior to ordering any equipment.

D. Quantity of Submittals Required:

1. Layout Shop Drawings:
 - a. Submit one reproducible transparency and one print.
 - b. Upon review, transparency will be annotated and returned. Print will be retained by Engineer.
 - c. Copies of this transparency will serve as record copies for Architect and Engineer.
 - d. Additional prints will not be reviewed nor returned.
2. Product data (brochures):
 - a. Submit six copies of product data.
 - b. Five copies will be returned.
 - c. If comments are required, comment sheet(s) will be returned with each copy.
 - d. One copy will be retained by the Engineer.
3. Samples:
 - a. Submit as directed by the architect and as required in each specification section.

E. Submittal Format:

1. Number each submittal in consecutive order.
2. Submit minimum one binder for each specific section. Different specification sections shall not be combined within same binder.
3. In each submittal include complete index with the following information:
 - a. Project title and number.
 - b. Submittal number.
 - c. Referenced specification DIVISION, Section, Title, paragraph and page number or drawing reference as applicable and flap each applicable item.
 - d. Date of submission.
 - e. Referenced addendum or change order number as applicable.
 - f. Names of Contractor, supplier and manufacturer.
 - g. Description of item.
 - h. Stamp with Contractor's initials or signed certifying:
 - 1) Review of submittal.
 - 2) Verification of products, field measurements and field construction

- criteria.
 - 3) Coordination of shop drawing and/or information in submittal with requirements of work of this Division and other divisions of Contract Documents.
 - 4. Nomenclature, legend, symbols and abbreviations on submitted material shall be same as used in contract documents.
- F. Resubmission Requirements:
- 1. Make any corrections or change in submittals required. Resubmit only items required for resubmittal for review until no exceptions are taken or a resubmission is not required.
 - 2. Shop Drawings and Product Data:
 - a. Revise initial drawings or data, and resubmit as specified for initial submittal.
 - b. Indicate any changes which have been made other than those requested.
 - c. Provide written response of all previous comments with the resubmittals.
 - 3. Samples: Submit new samples as required for initial submittal.
 - 4. Clearly identify resubmittal by original submittal date, number and revision number and indicate all changes from previous submittal.
- G. Substitutions:
- 1. In the event of conflict, the provisions of this paragraph shall override those contained in SUBMITTALS and SUBSTITUTIONS paragraphs in DIVISION 1.
 - 2. As a general, substitutions are not acceptable except for hereafter condition:
 - a. Requests for substitutions shall be considered only in case of product unavailability. Product unavailability shall be verified in writing by manufacturer.
 - b. Submit separate request for each substitution at appropriate time thereafter in the event of non-availability of item included in bid. Support each request with:
 - 1) Complete data substantiating compliance of proposed substitution with requirements stated in Contract documents.
 - 2) Data relating to changes in construction schedule.
 - 3) Any effect of substitution on other Work in this and other Divisions, and any other related contracts, and changes required in other work or products.
 - c. Contractor shall be responsible at no extra cost to Owner for any changes resulting from proposed substitutions which affect work of other Sections or Divisions, or related contracts.
 - d. Substitute products shall not be ordered or installed without prior acceptance by Architect.

- e. Architect will have sole discretion to determine acceptability of proposed substitutions and reserves the right to reject any such substitution.
- f. Approval of substitutions shall not relieve Contractor from full compliance with requirements of Contract documents.

H. Layout Shop Drawings Required:

- 1. Prepare and submit following coordinated layout shop drawings on 1/4" scale:
 - a. Mechanical equipment rooms containing motor control center and/or transformers.
 - b. All electrical rooms and closets with equipment dimensions.
 - c. Areas requiring deviations from design documents. Such deviations shall be clearly identified.
- 2. Layout drawings not varying from design documents shall not be submitted and will not be reviewed.

I. Operating Instructions, Maintenance Manuals and Parts Lists.

- 1. Before requesting acceptance of work submit one set for review by Architect.
- 2. After review, furnish five printed and bound sets.
- 3. Include:
 - a. Manufacturer's name, model number, service manual, spare-parts list, and descriptive literature for all components, cross referenced and numbered on Reference Drawings.
 - b. Maintenance instructions.
 - c. Listing of possible breakdown and repairs.
 - d. Instruction for starting, operation and programming.
 - e. Detailed and simplified one line and wiring diagrams.
 - f. Field test report.
 - g. Name, address and phone number of contractors, equipment suppliers and service agencies.
 - h. Assemble manufacturer's equipment manuals in chronological order following the specification alpha-numeric system in heavy duty three-ring binders clearly titled on the spine and front cover.

J. Record Drawings:

- 1. Comply with requirements of Section 01 7839 PROJECT RECORD DOCUMENTS.
- 2. Submit to Architect for review prior to final acceptance inspection, one complete marked-up set of reproducible drawings.
- 3. Submit to Architect for review prior to final acceptance inspection, one complete set of reproducible engineering design drawings on electronic files using ACAD and one vellum set.
 - a. Fully illustrate all revisions made by all trades.
 - b. Include all field changes, adjustments, variances, substitutions and deletions,

- c. including all changes made by Change Orders.
Exact location, type and function of all equipment.
- 4. These drawings shall be for record purposes for Owner's use and are not considered Shop Drawings.

1.10 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. To allow right of way for piping and conduit installed at required slope.
 - 4. So that connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.
- C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 08 Section "Access Doors and Frames."
- D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping".

PART 2 - PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and no side more than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches and 1 or more sides equal to, or more than, 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. Calpico, Inc.
 - c. Metraflex Co.
 - d. Pipeline Seal and Insulator, Inc.
 - 2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 3. Pressure Plates: Stainless steel. Include two for each sealing element.
 - 4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

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

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.
- E. Right of Way: Give to piping systems installed at a required slope.
- F. Layout and installation of electrical work shall be coordinated with the overall construction schedule and work schedules of various trades, to prevent delay in completion of the Project.

1. Complete drawings and specifications for the entire project will be available at the Project site.
 2. It shall be obligatory to thoroughly check these drawings before organizing the electrical work schedule, or installing material and equipment.
- G. Dimensions and information regarding accurate locations of equipment, and structural limitations and finish shall be coordinated and verified with other Division of Work. Be prepared to promptly furnish dimensions and information regarding electrical Work to other trades and cooperate with them to secure harmony and the best progress of the Project.
- H. The drawings do not show off-sets, bends, and special fittings, or junction or pull boxes necessary to meet job conditions. These items shall be provided as required at no additional cost to the Owner.
- I. Accessibility and Clearance:
1. Electrical equipment, outlets, junction and pull boxes shall be installed in accessible locations, avoiding obstructions, preserving headroom, and keeping openings and passageways clear.
 2. Minor adjustments in the locations of equipment shall be made where necessary, providing such adjustments do not adversely affect functioning of the equipment.
- J. Scaffolds and staging for installation of electrical work shall be provided under the work of this Division.
- 3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS
- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry

1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."
- K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.
- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 WEATHERPROOF EQUIPMENT

- A. Electrical devices or equipment located in damp, semi-exposed areas shall be weather-resistant. Enclosure shall comply with NEMA Type 3R requirements.
- B. Surface mounted outlet boxes shall be cast metal with threaded hubs. Pull or junction boxes shall be cast metal with bolted and gasketed covers.

- C. Outlet box covers shall be of a suitable weatherproof type with gaskets, packing glands, weatherproof doors, or other required means to prevent entry of moisture.
- D. Lighting fixtures shall be installed with suitable gasket, and UL labeled for location.

3.6 HOUSEKEEPING PADS AND FOUNDATIONS

- A. Concrete work required for housekeeping pads and foundations will be provided by General Construction Work. Comply with the requirement for concrete base specified in Division 03 section.
 - 1. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for anchoring equipment to the concrete base.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Bolt equipment to channel-iron sills embedded in concrete bases. Install sills level and grout flush with floor or base.
 - 6. Refinish damaged or scratched surfaces.
 - 7. Provide 24 inch wide insulating mat in front of operable electrical equipment and in front and rear of free standing ones.
 - 8. Tighten all bolted connections prior to energizing.
 - 9. Provide fuse cabinet with specified number of fuses of each type.
 - 10. Provide special tools as required for routing maintenance and inspection.
- B. Furnish required dimensional drawings and specify locations. Minimum height of housekeeping pads shall be 4 inches and shall extend out 6 inches from the footprint of the equipment.
- C. Furnish anchor bolts and sleeves, and verify accuracy of installation.
- D. Provide for:
 - 1. Switchboards, switchgears, unit substation and floor mounted ATS, MTS.
 - 2. Floor mounted transformers.
 - 3. Outdoor light fixture standards.
 - 4. All other floor mounted equipment.

END OF SECTION 260500

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. Copper building wire rated 600 V or less.
 - 2. Mineral-insulated cable, Type MI, rated 600 V or less.
 - 3. Tray cable, Type TC, rated 600 V or less.
 - 4. Fire-alarm wire and cable.
 - 5. Connectors, splices, and terminations rated 600 V and less.
- B. Related Requirements:
 - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2, and 3 control cables.

1.3 DEFINITIONS

- A. RoHS: Restriction of Hazardous Substances.
- B. VFC: Variable-frequency controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Product Schedule: Indicate type, use, location, and termination locations.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Member company of NETA.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

- A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alpha Wire Company.
 2. American Bare Conductor.
 3. Belden Inc.
 4. Cerro Wire LLC.
 5. Encore Wire Corporation.
 6. General Cable Technologies Corporation.
 7. Service Wire Co.
 8. Southwire Company.
 9. WESCO.
- C. Standards:
 1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B496 for stranded conductors.
- E. Conductor Insulation:
 1. Type NM: Comply with UL 83 and UL 719.
 2. Type RHH and Type RHW-2: Comply with UL 44.
 3. Type USE-2 and Type SE: Comply with UL 854.
 4. Type TC-ER: Comply with NEMA WC 70/ICEA S-95-658 and UL 1277.
 5. Type THHN and Type THWN-2: Comply with UL 83.
 6. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
 7. Type UF: Comply with UL 83 and UL 493.
 8. Type XHHW-2: Comply with UL 44.
- F. Shield:

1. Type TC-ER: Cable designed for use with VFCs, with oversized crosslinked polyethylene insulation, dual spirally wrapped copper tape shields and three bare symmetrically applied ground wires, and sunlight- and oil-resistant outer PVC jacket.

2.2 MINERAL-INSULATED CABLE, TYPE MI

- A. Description: Solid copper conductors encased in compressed metal oxide with an outer metallic sheath, rated 600 V or less.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Alpha Wire Company.
 2. American Bare Conductor.
 3. Belden Inc.
 4. Cerro Wire LLC.
 5. Encore Wire Corporation.
 6. General Cable Technologies Corporation.
 7. Service Wire Co.
 8. Southwire Company.
 9. WESCO.
- C. Standards:
 1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.
 2. UL 2196 for fire resistance.
 3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- D. Conductors: Copper, complying with ASTM B3 for bare annealed copper.
- E. Insulation: Compressed magnesium oxide
- F. Sheath: Copper

2.3 TRAY CABLE, TYPE TC

- A. Description: A factory assembly of insulated current-carrying conductors with or without an equipment grounding conductor in a nonmetallic jacket.
- B. Standards:
 1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.
 2. RoHS compliant.
 3. Comply with UL 1277.

4. Comply with ICEA S-73-532/NEMA WC 57 for Type TC cables used for control, thermocouple extension, and instrumentation.
 5. Comply with ICEA S-95-658/NEMA WC 70 for Type TC cables used for power distribution.
 6. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."
- C. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors
- D. Ground Conductor: Insulated
- E. Conductor Insulation: Type XHHW-2. Comply with UL 44.
- F. Shield: Metallic

2.4 FIRE-ALARM WIRE AND CABLE

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Allied Wire & Cable Inc.
 2. CommScope, Inc.
 3. Comtran Corporation.
 4. Draka Cableteq USA; a Prysmian Group company.
 5. Genesis Cable Products; Honeywell International, Inc.
 6. Radix Wire.
 7. Rockbestos-Suprenant Cable Corp.
 8. Superior Essex Inc.
 9. West Penn Wire.
- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with the CEC, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
1. Circuit Integrity Cable: Twisted shielded pair, the CEC, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
 2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 3. Multiconductor Armored Cable: the CEC, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer

jacket with red identifier stripe, NTRL listed for fire-alarm and cable tray installation, plenum rated.

2.5 CONNECTORS AND SPLICES

- A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M Electrical Products.
 - 2. AFC Cable Systems; a part of Atkore International.
 - 3. Gardner Bender.
 - 4. Hubbell Power Systems, Inc.
 - 5. Ideal Industries, Inc.
 - 6. ILSCO.
 - 7. NSi Industries LLC.
 - 8. O- /Gedney; a brand of Emerson Industrial Automation.
 - 9. Service Wire Co.
 - 10. TE Connectivity Ltd.
 - 11. Thomas & Betts Corporation; A Member of the ABB Group.
- C. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.
- D. Lugs: One piece, seamless, designed to terminate conductors specified in this Section.
 - 1. Material: Copper.
 - 2. Type: One or Two hole with standard barrels.
 - 3. Termination: Compression.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

- A. Feeders: Copper; solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.
- C. VFC Output Circuits Cable: Extra-flexible stranded for all sizes.
- D. Power-Limited Fire Alarm and Control: Solid for No. 12 AWG and smaller.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

- A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.
- B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.
- C. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- D. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway.
- E. Feeders Installed below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- G. Exposed Branch Circuits, Including in Crawlspace: Type THHN/THWN-2, single conductors in raceway.
- H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
- I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN-2, single conductors in raceway Underground branch-circuit cable, Type UF.
- J. Branch Circuits Installed Below Raised Flooring: Type THHN/THWN-2, single conductors in raceway.
- K. Branch Circuits in Cable Tray: Type THHN/THWN-2, single conductors in raceway.
- L. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.
- M. VFC Output Circuits: Type XHHW-2 in metal conduit.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.
- B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.
- C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

- D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.
- E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members and follow surface contours where possible.
- F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."
- G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.4 INSTALLATION OF FIRE-ALARM WIRING

- A. If conflict arises between this spec section and fire-alarm specs, the fire-alarm specs supersedes this spec section.
- B. Comply with NECA 1 and NFPA 72.
- C. Wiring Method: Install wiring in metal pathway according to Section 270528.29 "Hangers and Supports for Communications Systems."
 - 1. Install plenum cable in environmental airspaces, including plenum ceilings.
 - 2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.
- D. Wiring Method:
 - 1. Cables and pathways used for fire-alarm circuits, and equipment control wiring associated with fire-alarm system, may not contain any other wire or cable.
 - 2. Fire-Rated Cables: Use of two-hour, fire-rated fire-alarm cables, the CEC, Types MI and CI, is permitted.
 - 3. Signaling Line Circuits: Power-limited fire-alarm cables may be installed in the same cable or pathway as signaling line circuits.
- E. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with fire-alarm system to terminal blocks. Mark each terminal according to system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.
- F. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes; cabinets; or equipment enclosures where circuit connections are made.
- G. Color-Coding: Color-code fire-alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and another for supervisory circuits. Color-

code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire-alarm system junction boxes and covers red.

- H. Risers: Install at least two vertical cable risers to serve the fire-alarm system. Separate risers in close proximity to each other with a minimum one-hour-rated wall, so the loss of one riser does not prevent receipt or transmission of signals from other floors or zones.
- I. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 CONNECTIONS

- A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
 - 1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.
- C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.
- D. Comply with requirements in Section 284621.11 "Addressable Fire-Alarm System" for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

- A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."
- B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

- A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
 - 1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.
 - 2. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors and conductors feeding the following critical equipment and services for compliance with requirements:
 - 3. Perform each of the following visual and electrical tests:
 - a. Inspect exposed sections of conductor and cable for physical damage and correct connection according to the single-line diagram.
 - b. Test bolted connections for high resistance using one of the following:
 - 1) A low-resistance ohmmeter.
 - 2) Calibrated torque wrench.
 - 3) Thermographic survey.
 - c. Inspect compression-applied connectors for correct cable match and indentation.
 - d. Inspect for correct identification.
 - e. Inspect cable jacket and condition.
 - f. Insulation-resistance test on each conductor for ground and adjacent conductors. Apply a potential of 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable for a one-minute duration.
 - g. Continuity test on each conductor and cable.
 - h. Uniform resistance of parallel conductors.
 - 4. Initial Infrared Scanning: After Substantial Completion, but before Final Acceptance, perform an infrared scan of each splice in conductors No. 3 AWG and larger. Remove box and equipment covers so splices are accessible to portable scanner. Correct deficiencies determined during the scan.
 - a. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

- b. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
- 5. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.
- D. Cables will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports to record the following:
 - 1. Procedures used.
 - 2. Results that comply with requirements.
 - 3. Results that do not comply with requirements, and corrective action taken to achieve compliance with requirements.

END OF SECTION 260519

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. Backboards.
 - 2. Category 5e balanced twisted pair cable.
 - 3. Category 6 balanced twisted pair cable.
 - 4. Category 6a balanced twisted pair cable.
 - 5. Balanced twisted pair cabling hardware.
 - 6. RS-485 cabling.
 - 7. Low-voltage control cabling.
 - 8. Control-circuit conductors.
 - 9. Identification products.

1.3 DEFINITIONS

- A. EMI: Electromagnetic interference.
- B. Low Voltage: As defined in the CEC for circuits and equipment operating at less than 50 V or for remote-control and signaling power-limited circuits.
- C. Plenum: A space forming part of the air distribution system to which one or more air ducts are connected. An air duct is a passageway, other than a plenum, for transporting air to or from heating, ventilating, or air-conditioning equipment.
- D. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

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

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency, RCDD, layout technician, installation supervisor, and field inspector.

- B. Source quality-control reports.
- C. Field quality-control reports.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. Flame Travel and Smoke Density in Plenums: As determined by testing identical products according to NFPA 262, by a qualified testing agency. Identify products for installation in plenums with appropriate markings of applicable testing agency.
 - 1. Flame Travel Distance: 60 inches or less.
 - 2. Peak Optical Smoke Density: 0.5 or less.
 - 3. Average Optical Smoke Density: 0.15 or less.
- C. Flame Travel and Smoke Density for Riser Cables in Non-Plenum Building Spaces: As determined by testing identical products according to UL 1666.
- D. Flame Travel and Smoke Density for Cables in Non-Riser Applications and Non-Plenum Building Spaces: As determined by testing identical products according to UL 1685.
- E. RoHS compliant.

2.2 BACKBOARDS

- A. Description: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels in Section 061000 "Rough Carpentry."
- B. Painting: Paint plywood on all sides and edges with flat latex paint. Comply with requirements in Section 099123 "Interior Painting."

2.3 CATEGORY 6a BALANCED TWISTED PAIR CABLE

- A. Description: Four-pair, balanced-twisted pair cable, with internal spline, certified to meet transmission characteristics of Category 6a cable at frequencies up to 500MHz
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. 3M.
 - 2. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 3. Belden CDT Networking Division/NORDX.
 - 4. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 5. CommScope, Inc.
 - 6. Draka USA.
 - 7. General Cable; General Cable Corporation.
 - 8. Genesis Cable Products; Honeywell International, Inc.
 - 9. Hitachi Cable America Inc.
 - 10. Mohawk; a division of Belden Networking, Inc.
 - 11. Superior Essex Inc.
 - 12. SYSTIMAX Solutions; a CommScope Inc. brand.
- C. Standard: Comply with TIA-568-C.2 for Category 6a cables.
- D. Conductors: 100-ohm, 22 AWG solid copper.
- E. Shielding/Screening: Unshielded twisted pairs (UTP).
- F. Cable Rating: Plenum.
- G. Jacket: Blue thermoplastic.

2.4 BALANCED TWISTED PAIR CABLE HARDWARE

- A. Description: Hardware designed to connect, splice, and terminate balanced twisted pair copper communications cable.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. 3M.
 - 2. American Technology Systems Industries, Inc.
 - 3. AMP NETCONNECT; a TE Connectivity Ltd. company.
 - 4. Belden CDT Networking Division/NORDX.
 - 5. Berk-Tek Leviton; a Nexans/Leviton alliance.
 - 6. CommScope, Inc.
 - 7. Draka USA.
 - 8. Dynacom Corporation.
 - 9. General Cable; General Cable Corporation.

10. Genesis Cable Products; Honeywell International, Inc.
11. Hubbell Premise Wiring.
12. KRONE Incorporated.
13. Leviton Manufacturing Co., Inc.
14. Mohawk; a division of Belden Networking, Inc.
15. Molex Premise Networks.
16. Panduit Corp.
17. Siemon Co. (The).
18. Superior Essex Inc.
19. SYSTIMAX Solutions; a CommScope Inc. brand.

C. General Requirements for Balanced Twisted Pair Cable Hardware:

1. Comply with the performance requirements of Category 6a.
2. Comply with TIA-568-C.2, IDC type, with modules designed for punch-down caps or tools.
3. Cables shall be terminated with connecting hardware of same category or higher.

D. Source Limitations: Obtain balanced twisted pair cable hardware from single source from single manufacturer.

E. Connecting Blocks: 110-style IDC for Category 6. Provide blocks for the number of cables terminated on the block, plus 25 percent spare, integral with connector bodies, including plugs and jacks where indicated.

1. Number of Terminals per Field: One for each conductor in assigned cables.

F. Patch Panel: Modular panels housing numbered jack units with IDC-type connectors at each jack location for permanent termination of pair groups of installed cables.

1. Features:
 - a. Universal T568A and T568B wiring labels.
 - b. Labeling areas adjacent to conductors.
 - c. Replaceable connectors.
 - d. 24 or 48 ports.
2. Construction: 16-gauge steel and mountable on 19-inch equipment racks.
3. Number of Jacks per Field: One for each four-pair cable indicated.

G. Patch Cords: Factory-made, four-pair cables in 36-inch lengths; terminated with an eight-position modular plug at each end.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure performance. Patch cords shall have latch guards to protect against snagging.

H. Plugs and Plug Assemblies:

1. Male; eight position; color-coded modular telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
2. Comply with IEC 60603-7-1, IEC 60603-7-2, IEC 60603-7-3, IEC 60603-7-4, and IEC 60603-7.5.
3. Marked to indicate transmission performance.

I. Jacks and Jack Assemblies:

1. Female; eight position; modular; fixed telecommunications connector designed for termination of a single four-pair 100-ohm unshielded or shielded balanced twisted pair cable.
2. Designed to snap-in to a patch panel or faceplate.
3. Standards:
 - a. Category 5e, unshielded balanced twisted pair cable shall comply with IEC 60603-7-2.
 - b. Category 5e, shielded balanced twisted pair cable shall comply with IEC 60603-7-3.
 - c. Category 6, unshielded balanced twisted pair cable shall comply with IEC 60603-7-4.
 - d. Category 6, shielded balanced twisted pair cable shall comply with IEC 60603-7.5.
 - e. Category 6a, unshielded balanced twisted pair cable shall comply with IEC 60603-7-41.
 - f. Category 6a, shielded balanced twisted pair cable shall comply with IEC 60603-7.51.
4. Marked to indicate transmission performance.

J. Faceplate:

1. Four port, vertical single-gang faceplates designed to mount to single-gang wall boxes.
2. Twelve port, vertical double-gang faceplates designed to mount to double-gang wall boxes.
3. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
4. Metal Faceplate: Stainless steel, complying with requirements in Section 262726 "Wiring Devices."
5. For use with snap-in jacks accommodating any combination of balanced twisted pair, optical fiber, and coaxial work area cords.
 - a. Flush mounting jacks, positioning the cord at a 45-degree angle.

K. Legend:

1. Machine printed, in the field, using adhesive-tape label.
2. Snap-in, clear-label covers and machine-printed paper inserts.

2.5 LOW-VOLTAGE CONTROL CABLE

A. Paired Cable: the CEC, Type CMG.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with UL 1685.

B. Plenum-Rated, Paired Cable: the CEC, Type CMP.

1. Multi-pair, twisted, No. 16 AWG, stranded (19x29) tinned-copper conductors.
2. PVC insulation.
3. Unshielded.
4. PVC jacket.
5. Flame Resistance: Comply with NFPA 262.

2.6 CONTROL-CIRCUIT CONDUCTORS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Encore Wire Corporation.
2. General Cable; General Cable Corporation.
3. Service Wire Co.
4. Southwire Company.

B. Class 1 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

C. Class 2 Control Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

D. Class 3 Remote-Control and Signal Circuits: Stranded copper, Type THHN/THWN-2, complying with UL 83 in raceway.

E. Class 2 Control Circuits and Class 3 Remote-Control and Signal Circuits That Supply Critical Circuits: Circuit Integrity (CI) cable.

1. Smoke control signaling and control circuits.

2.7 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allied Wire & Cable Inc.
2. CommScope, Inc.
3. Comtran Corporation.
4. Draka Cableteq USA; a Prysmian Group company.
5. Genesis Cable Products; Honeywell International, Inc.
6. Radix Wire.
7. Rockbestos-Suprenant Cable Corp.
8. Superior Essex Inc.
9. West Penn Wire.

- B. General Wire and Cable Requirements: NRTL listed and labeled as complying with the CEC, Article 760.
- C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 18 AWG.
1. Circuit Integrity Cable: Twisted shielded pair, the CEC, Article 760, Classification CI, for power-limited fire-alarm signal service Type FPL. NRTL listed and labeled as complying with UL 1424 and UL 2196 for a two-hour rating.
- D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.
1. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.
 2. Multiconductor Armored Cable: the CEC, Type MC, copper conductors, Type TFN/THHN conductor insulation, copper drain wire, copper armor with outer jacket with red identifier stripe, NRTL listed for fire-alarm and cable tray installation, plenum rated.

2.8 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate cables.
- B. Factory test twisted pair cables according to TIA-568-C.2.
- C. Cable will be considered defective if it does not pass tests and inspections.
- D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Test cables on receipt at Project site.
1. Test each pair of twisted pair cable for open and short circuits.

3.2 INSTALLATION OF RACEWAYS AND BOXES

- A. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for raceway selection and installation requirements for boxes, conduits, and wireways as supplemented or modified in this Section.
 - 1. Outlet boxes shall be no smaller than 2 inches wide, 3 inches high, and 2-1/2 inches deep.
 - 2. Flexible metal conduit shall not be used.
- B. Comply with TIA-569-D for pull-box sizing and length of conduit and number of bends between pull points.
- C. Install manufactured conduit sweeps and long-radius elbows if possible.
- D. Raceway Installation in Equipment Rooms:
 - 1. Position conduit ends adjacent to a corner on backboard if a single piece of plywood is installed, or in the corner of the room if multiple sheets of plywood are installed around perimeter walls of the room.
 - 2. Install cable trays to route cables if conduits cannot be located in these positions.
 - 3. Secure conduits to backboard if entering the room from overhead.
 - 4. Extend conduits 3 inches above finished floor.
 - 5. Install metal conduits with grounding bushings and connect with grounding conductor to grounding system.
- E. Backboards: Install backboards with 96-inch dimension vertical. Butt adjacent sheets tightly and form smooth gap-free corners and joints.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

- A. Comply with NECA 1.
- B. General Requirements for Cabling:
 - 1. Comply with TIA-568-C Series of standards.
 - 2. Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems."
 - 3. Terminate all conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, and cross-connect and patch panels.
 - 4. Cables may not be spliced and shall be continuous from terminal to terminal. Do not splice cable between termination, tap, or junction points.
 - 5. Cables serving a common system may be grouped in a common raceway. Install network cabling and control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
 - 6. Secure and support cables at intervals not exceeding 30 inches and not more than 6 inches from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
 - 7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Install lacing bars and distribution spools.

8. Do not install bruised, kinked, scored, deformed, or abraded cable. Remove and discard cable if damaged during installation and replace it with new cable.
9. Cold-Weather Installation: Bring cable to room temperature before dereeling. Do not use heat lamps for heating.
10. Pulling Cable: Comply with BICSI ITSIMM, Ch. 5, "Copper Structured Cabling Systems." Monitor cable pull tensions.
11. Support: Do not allow cables to lie on removable ceiling tiles.
12. Secure: Fasten securely in place with hardware specifically designed and installed so as to not damage cables.
13. Provide strain relief.
14. Keep runs short. Allow extra length for connecting to terminals. Do not bend cables in a radius less than 10 times the cable OD. Use sleeves or grommets to protect cables from vibration at points where they pass around sharp corners and through penetrations.
15. Ground wire shall be copper, and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

C. Balanced Twisted Pair Cable Installation:

1. Comply with TIA-568-C.2.
2. Do not untwist balanced twisted pair cables more than 1/2 inch at the point of termination to maintain cable geometry.

D. Installation of Control-Circuit Conductors:

1. Install wiring in raceways.
2. Use insulated spade lugs for wire and cable connection to screw terminals.
3. Comply with requirements specified in Section 260533 "Raceways and Boxes for Electrical Systems."

E. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend copper cable not in a wireway or pathway a minimum of 8 inches above ceilings by cable supports not more than 30 inches apart.
3. Cable shall not be run through or on structural members or in contact with pipes, ducts, or other potentially damaging items. Do not run cables between structural members and corrugated panels.

F. Installation of Cable Routed Exposed under Raised Floors:

1. Install plenum-rated cable only.
2. Install cabling after the flooring system has been installed in raised floor areas.
3. Below each feed point, neatly coil a minimum of 72 inches of cable in a coil not less than 12 inches in diameter.

G. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-D recommendations for separating unshielded copper voice and data communications cable from potential EMI sources including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 5 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 12 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 24 inches.
3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 6 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 12 inches.
4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:
 - a. Electrical Equipment or Circuit Rating Less Than 2 kVA: No requirement.
 - b. Electrical Equipment or Circuit Rating between 2 and 5 kVA: A minimum of 3 inches.
 - c. Electrical Equipment or Circuit Rating More Than 5 kVA: A minimum of 6 inches.
5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.4 REMOVAL OF CONDUCTORS AND CABLES

- A. Remove abandoned conductors and cables. Abandoned conductors and cables are those installed that are not terminated at equipment and are not identified with a tag for future use.

3.5 CONTROL-CIRCUIT CONDUCTORS

- A. Minimum Conductor Sizes:

1. Class 1 remote-control and signal circuits; No 14 AWG.

2. Class 2 low-energy, remote-control, and signal circuits; No. 16 AWG.
3. Class 3 low-energy, remote-control, alarm, and signal circuits; No 12 AWG.

3.6 FIRESTOPPING

- A. Comply with requirements in Section 078413 "Penetration Firestopping."
- B. Comply with TIA-569-D, Annex A, "Firestopping."
- C. Comply with BICSI TDMM, "Firestopping" Chapter.

3.7 GROUNDING

- A. For data communication wiring, comply with TIA-607-B and with BICSI TDMM, "Bonding and Grounding (Earthing)" Chapter.
- B. For low-voltage control wiring and cabling, comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems."

3.8 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Identify data and communications system components, wiring, and cabling according to TIA-606-B; label printers shall use label stocks, laminating adhesives, and inks complying with UL 969.
- C. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.

3.9 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections:
 1. Visually inspect cable jacket materials for UL or third-party certification markings. Inspect cabling terminations to confirm color-coding for pin assignments and inspect cabling connections to confirm compliance with TIA-568-C.1.

2. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.
3. Test cabling for direct-current loop resistance, shorts, opens, intermittent faults, and polarity between conductors. Test operation of shorting bars in connection blocks. Test cables after termination, but not after cross-connection.
 - a. Test instruments shall meet or exceed applicable requirements in TIA-568-C.2. Perform tests with a tester that complies with performance requirements in its "Test Instruments (Normative)" Annex, complying with measurement accuracy specified in its "Measurement Accuracy (Informative)" Annex. Use only test cords and adapters that are qualified by test equipment manufacturer for channel or link test configuration.
- E. Document data for each measurement. Print data for submittals in a summary report that is formatted using Table 10.1 in BICSI TDMM as a guide, or transfer the data from the instrument to the computer, save as text files, print, and submit.
- F. End-to-end cabling will be considered defective if it does not pass tests and inspections.
- G. Prepare test and inspection reports.

END OF SECTION 260523

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

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 grounding and bonding systems and equipment.
 - 1. Underground distribution grounding.
 - 2. Foundation steel electrodes.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans showing dimensioned locations of grounding features specified in "Field Quality Control" Article, including the following:
 - 1. Test wells.
 - 2. Ground rods.
 - 3. Ground rings.
 - 4. Grounding arrangements and connections for separately derived systems.
- B. Qualification Data: For testing agency and testing agency's field supervisor.
- C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.
 - 1. Include the following:
 - a. Plans showing as-built, dimensioned locations of system described in "Field Quality Control" Article, including the following:

- 1) Test wells.
 - 2) Ground rods.
 - 3) Ground rings.
 - 4) Grounding arrangements and connections for separately derived systems.
- b. Instructions for periodic testing and inspection of grounding features at test wells grounding connections for separately derived systems based on NETA MTS.
- 1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.
 - 2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advanced Lightning Technology, Ltd.
 2. Burndy; Part of Hubbell Electrical Systems.
 3. Dossert; AFL Telecommunications LLC.
 4. ERICO; a brand of nVent.
 5. Fushi Copperweld Inc.
 6. Galvan Industries, Inc.; Electrical Products Division, LLC.
 7. Harger Lightning & Grounding.
 8. ILSCO.
 9. O- /Gedney; a brand of Emerson Industrial Automation.
 10. Robbins Lightning, Inc.
 11. Siemens Industry, Inc., Energy Management Division.
 12. Thomas & Betts Corporation; A Member of the ABB Group.

2.3 CONDUCTORS

- A. Insulated Conductors: tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.
- B. Bare Copper Conductors:
 - 1. Solid Conductors: ASTM B3.
 - 2. Stranded Conductors: ASTM B8.
 - 3. Tinned Conductors: ASTM B33.
 - 4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
 - 5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
 - 6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
 - 7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
- C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

- A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.
- B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.
- C. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
- D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.
- E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.
- F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.
- G. Conduit Hubs: Mechanical type, terminal with threaded hub.
- H. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- I. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.
- J. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

- K. Service Post Connectors: Mechanical type, bronze alloy terminal, in short- and long-stud lengths, capable of single and double conductor connections.
- L. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.
- M. Straps: Solid copper, copper lugs. Rated for 600 A.
- N. Tower Ground Clamps: Mechanical type, copper or copper alloy, terminal two-piece clamp.
- O. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.
- P. Water Pipe Clamps:
 - 1. Mechanical type, two pieces with zinc-plated bolts.
 - a. Material: Die-cast zinc alloy.
 - b. Listed for direct burial.
 - 2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

- A. Ground Rods: zinc-coated steel; 3/4 inch by 10 feet.
- B. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

- A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.
- B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.
 - 1. Bury at least 30 inches below grade.
 - 2. Duct-Bank Grounding Conductor: Bury 12 inches above duct bank when indicated as part of duct-bank installation.
- C. Grounding Conductors: Green-colored insulation with continuous yellow stripe.
- D. Isolated Grounding Conductors: Green-colored insulation with more than one continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

- E. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
 - 1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
 - 2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.
- F. Conductor Terminations and Connections:
 - 1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
 - 2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
 - 3. Connections to Ground Rods at Test Wells: Bolted connectors.
 - 4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

- A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

- A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

- A. Comply with IEEE C2 grounding requirements.
- B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
- C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.
- D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with

substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches from the foundation.

3.5 EQUIPMENT GROUNDING

- A. Install insulated equipment grounding conductors with all feeders and branch circuits.
- B. Install insulated equipment grounding conductors with the following items, in addition to those required by the CEC:
 - 1. Feeders and branch circuits.
 - 2. Lighting circuits.
 - 3. Receptacle circuits.
 - 4. Single-phase motor and appliance branch circuits.
 - 5. Three-phase motor and appliance branch circuits.
 - 6. Flexible raceway runs.
 - 7. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.
 - 8. X-Ray Equipment Circuits: Install insulated equipment grounding conductor in circuits supplying x-ray equipment.
- C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
- D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.
- E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.
- G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.
- H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare, tinned copper, not less than No. 8 AWG.
2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.
3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

- A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.
- B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.
- C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
 1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
 2. Use exothermic welds for all below-grade connections.
 3. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
- D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches deep, with cover.
 1. Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.
- E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
 1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
 2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
 3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.
- F. Grounding and Bonding for Piping:
 1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service

- entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.
 3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.
- G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install tinned bonding jumper to bond across flexible duct connections to achieve continuity.
- H. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.
- I. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of building.
1. Install tinned-copper conductor not less than No. 2/0 AWG for ground ring and for taps to building steel.
 2. Bury ground ring not less than 24 inches from building's foundation.
- J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to the CEC; use a minimum of 20 feet of bare copper conductor not smaller than No. 3/0 AWG.
1. If concrete foundation is less than 20 feet long, coil excess conductor within base of foundation.
 2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.
- K. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to the CEC; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.
- L. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.
1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in order of galvanic series.
 2. Make connections with clean, bare metal at points of contact.
 3. Make aluminum-to-steel connections with stainless-steel separators and mechanical clamps.
 4. Make aluminum-to-galvanized-steel connections with tin-plated copper jumpers and mechanical clamps.

5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
 2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
 3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.
 - a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
 - b. Perform tests by fall-of-potential method according to IEEE 81.
 4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.
- D. Grounding system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Report measured ground resistances that exceed the following values:
 1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
 2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
 3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
 4. Power Distribution Units or Panelboards Serving Electronic Equipment: 1 ohm(s).
 5. Substations and Pad-Mounted Equipment: 5 ohms.
 6. Manhole Grounds: 10 ohms.
 7. ohms.

- G. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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. Steel slotted support systems.
2. Aluminum slotted support systems.
3. Conduit and cable support devices.
4. Support for conductors in vertical conduit.
5. Structural steel for fabricated supports and restraints.
6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
7. Fabricated metal equipment support assemblies.

- B. Related Requirements:

1. Section 260548.16 "Seismic Controls for Electrical Systems" for products and installation requirements necessary for compliance with seismic criteria.

1.3 ACTION SUBMITTALS

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

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
 - a. Slotted support systems, hardware, and accessories.
 - b. Clamps.
 - c. Hangers.
 - d. Sockets.
 - e. Eye nuts.
 - f. Fasteners.
 - g. Anchors.
 - h. Saddles.
 - i. Brackets.

2. Include rated capacities and furnished specialties and accessories.
- B. Shop Drawings: Signed and sealed by a qualified professional engineer. For fabrication and installation details for electrical hangers and support systems.
1. Hangers. Include product data for components.
 2. Slotted support systems.
 3. Equipment supports.
 4. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include adjustable motor bases, rails, and frames for equipment mounting.
- C. Delegated-Design Submittal: For hangers and supports for electrical systems.
1. Include design calculations and details of hangers.
 2. Include design calculations for seismic restraints.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Suspended ceiling components.
 2. Ductwork, piping, fittings, and supports.
 3. Structural members to which hangers and supports will be attached.
 4. Size and location of initial access modules for acoustical tile.
 5. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Projectors.
- B. Seismic Qualification Data: Certificates, for hangers and supports for electrical equipment and systems, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- C. Welding certificates.

1.5 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1/D1.1M.
 - 2. AWS D1.2/D1.2M.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer to design hanger and support system.
- B. Seismic Performance: Hangers and supports shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the supported equipment and systems will remain in place without separation of any parts when subjected to the seismic forces specified and the supported equipment and systems will be fully operational after the seismic event."
 - 2. Component Importance Factor: 1.5.
- C. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 - 1. Flame Rating: Class 1.
 - 2. Self-extinguishing according to ASTM D635.
- D. All hangers and supports shall be anti-corrosive and suitable for marine environment.

2.2 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

- A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. B-line, an Eaton business.
 - c. CADDY; a brand of nVent.
 - d. Flex-Strut Inc.
 - e. Gripple Inc.
 - f. GS Metals Corp.
 - g. G-Strut.
 - h. Haydon Corporation.
 - i. Metal Ties Innovation.

- j. MIRO Industries.
 - k. Thomas & Betts Corporation; A Member of the ABB Group.
 - l. Unistrut; Part of Atkore International.
 - m. Wesanco, Inc.
- 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Material for Channel, Fittings, and Accessories: Galvanized steel.
 - 4. Channel Width: Selected for applicable load criteria.
 - 5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cooper Industries, Inc.
 - b. Flex-Strut Inc.
 - c. Haydon Corporation.
 - d. MKT Metal Manufacturing.
 - e. Thomas & Betts Corporation; A Member of the ABB Group.
 - f. Unistrut; Part of Atkore International.
 - 2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
 - 3. Channel Material: 6063-T5 aluminum alloy.
 - 4. Fittings and Accessories Material: 5052-H32 aluminum alloy.
 - 5. Channel Width: Selected for applicable load criteria.
 - 6. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
 - 7. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.
 - 8. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.
- D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for nonarmored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be made of malleable iron.

- E. Structural Steel for Fabricated Supports and Restraints: ASTM A36/A36M steel plates, shapes, and bars; black and galvanized.
- F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
 - 1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) Hilti, Inc.
 - 2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 3) MKT Fastening, LLC.
 - 4) Simpson Strong-Tie Co., Inc.
 - 2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
 - a. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1) B-line, an Eaton business.
 - 2) Empire Tool and Manufacturing Co., Inc.
 - 3) Hilti, Inc.
 - 4) ITW Ramset/Red Head; Illinois Tool Works, Inc.
 - 5) MKT Fastening, LLC.
 - 3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.
 - 4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.
 - 5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F3125/F3125M, Grade A325.
 - 6. Toggle Bolts: All-steel springhead type.
 - 7. Hanger Rods: Threaded steel.

2.3 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

- A. Description: Welded or bolted structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
- B. Materials: Comply with requirements in Section 055500 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

- A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
 - 1. NECA 1.
 - 2. NECA 101
- B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.
- C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by the CEC. Minimum rod size shall be 1/4 inch in diameter.
- E. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
 - 1. Secure raceways and cables to these supports with two-bolt conduit clamps.
- F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

- A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this article.
- B. Raceway Support Methods: In addition to methods described in NECA 1, EMT and RMC may be supported by openings through structure members, according to the CEC.
- C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.
- D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 4. To Existing Concrete: Expansion anchor fasteners.
 5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
 6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.
 7. To Light Steel: Sheet metal screws.
 8. 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 comply with seismic-restraint strength and anchorage requirements.
- E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

- A. Comply with installation requirements in Section 055500 "Metal Fabrications" for site-fabricated metal supports.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.
- C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

- A. Construct concrete bases of dimensions indicated, but not less than 4 inches 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, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."
- C. Anchor equipment to concrete base as follows:
 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 manufacturer's written instructions.

3.5 PAINTING

- A. Touchup: 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 minimum dry film thickness of 2.0 mils.
- B. Touchup: Comply with requirements in Section 099123 "Interior Painting" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.
- C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A780.

END OF SECTION 260529

SECTION 260533 – RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

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. Metal conduits and fittings.
2. Nonmetallic conduits and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

- B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for firestopping at conduit and box entrances.
2. Section 260543 "Underground Ducts and Raceways for Electrical Systems" for exterior ductbanks, manholes, and underground utility construction.
3. Section 270528 "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS

- A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
- B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of items involved:
 - 1. Structural members in paths of conduit groups with common supports.
 - 2. HVAC and plumbing items and architectural features in paths of conduit groups with common supports.
- B. Qualification Data: For professional engineer.
- C. Seismic Qualification Data: Certificates, for enclosures, cabinets, and conduit racks and their mounting provisions, including those for internal components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Detailed description of conduit support devices and interconnections on which the certification is based and their installation requirements.
- D. Source quality-control reports.

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Metal Conduit:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. Calconduit.
 - e. Electri-Flex Company.
 - f. FSR Inc.
 - g. Korkap.
 - h. NEC, Inc.
 - i. Opti-Com Manufacturing Network, Inc (OMNI).
 - j. O- /Gedney; a brand of Emerson Industrial Automation.
 - k. Patriot Aluminum Products, LLC.
 - l. Perma-Cote.

- m. Picoma Industries, Inc.
 - n. Plasti-Bond.
 - o. Republic Conduit.
 - p. Southwire Company.
 - q. Thomas & Betts Corporation; A Member of the ABB Group.
 - r. Topa Electric; a division of Topa Lighting Corp.
 - s. Western Tube and Conduit Corporation.
 - t. Wheatland Tube Company.
- 2. Listing and Labeling: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 - 3. GRC: Comply with ANSI C80.1 and UL 6.
 - 4. IMC: Comply with ANSI C80.6 and UL 1242.
 - 5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
 - a. Comply with NEMA RN 1.
 - b. Coating Thickness: 0.040 inch, minimum.
 - 6. EMT: Comply with ANSI C80.3 and UL 797.
 - 7. FMC: Comply with UL 1; inc-coated steel.
 - 8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Allied Tube & Conduit; a part of Atkore International.
 - c. Anamet Electrical, Inc.
 - d. Calconduit.
 - e. Electri-Flex Company.
 - f. FSR Inc.
 - g. Korkap.
 - h. NEC, Inc.
 - i. NewBasis.
 - j. Opti-Com Manufacturing Network, Inc (OMNI).
 - k. O- /Gedney; a brand of Emerson Industrial Automation.
 - l. Patriot Aluminum Products, LLC.
 - m. Perma-Cote.
 - n. Picoma Industries, Inc.
 - o. Plasti-Bond.
 - p. Republic Conduit.
 - q. Southwire Company.
 - r. Thomas & Betts Corporation; A Member of the ABB Group.
 - s. Topa Electric; a division of Topa Lighting Corp.
 - t. Western Tube and Conduit Corporation.
 - u. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.
 3. Listing and Labeling: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 4. Fittings, General: Listed and labeled for type of conduit, location, and use.
 5. Fittings for EMT:
 - a. Material: die cast.
 - b. Type: compression.
 6. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
 7. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
- C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in the CEC, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Arnco Corporation.
 - d. CANTEX INC.
 - e. CertainTeed Corporation.
 - f. Champion Fiberglass, Inc.
 - g. Condux International, Inc.
 - h. Electri-Flex Company.
 - i. FRE Composites.
 - j. Kraloy.
 - k. Lamson & Sessions.
 - l. Niedax Inc.
 - m. RACO; Hubbell.
 - n. Thomas & Betts Corporation; A Member of the ABB Group.
 - o. United Fiberglass.
2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
3. Fiberglass:
 - a. Comply with NEMA TC 14.

- b. Comply with UL 2515 for aboveground raceways.
- c. Comply with UL 2420 for belowground raceways.
- 4. ENT: Comply with NEMA TC 13 and UL 1653.
- 5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.
- 6. LFNC: Comply with UL 1660.
- 7. Rigid HDPE: Comply with UL 651A.
- 8. Continuous HDPE: Comply with UL 651A.
- 9. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D3485.
- 10. RTRC: Comply with UL 2515A and NEMA TC 14.

B. Nonmetallic Fittings:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. AFC Cable Systems; a part of Atkore International.
 - b. Anamet Electrical, Inc.
 - c. Arnco Corporation.
 - d. CANTEX INC.
 - e. CertainTeed Corporation.
 - f. Champion Fiberglass, Inc.
 - g. Condux International, Inc.
 - h. Electri-Flex Company.
 - i. FRE Composites.
 - j. Kraloy.
 - k. Lamson & Sessions.
 - l. Niedax Inc.
 - m. RACO; Hubbell.
 - n. Thomas & Betts Corporation; A Member of the ABB Group.
 - o. United Fiberglass.
- 2. Fittings, General: Listed and labeled for type of conduit, location, and use.
- 3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
 - a. Fittings for LFNC: Comply with UL 514B.
- 4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. MonoSystems, Inc.
4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 3R Type 4 Type 12 Insert type unless otherwise indicated, and sized according to the CEC.

1. Metal wireways installed outdoors shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 NONMETALLIC WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Allied Moulded Products, Inc.
2. Hoffman; a brand of nVent.
3. Lamson & Sessions.
4. Niedax Inc.
5. PANDUIT.

B. Listing and Labeling: Nonmetallic wireways and auxiliary gutters shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.

C. Description: Fiberglass polyester, extruded and fabricated to required size and shape, without holes or knockouts. Cover shall be gasketed with oil-resistant gasket material and fastened with captive screws treated for corrosion resistance. Connections shall be flanged and have stainless-steel screws and oil-resistant gaskets.

D. Description: PVC, extruded and fabricated to required size and shape, and having snap-on cover, mechanically coupled connections, and plastic fasteners.

E. Fittings and Accessories: Couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings shall match and mate with wireways as required for complete system.

F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.5 SURFACE RACEWAYS

- A. Listing and Labeling: Surface raceways and tele-power poles shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. All exterior raceways shall be anti-corrosive and suitable for marine environment.
- C. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finish in color selected by Architect.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.
- D. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Hubbell Incorporated.
 - b. MonoSystems, Inc.
 - c. Panduit Corp.
 - d. Wiremold / Legrand.

2.6 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Adalet.
 - 2. Crouse-Hinds, an Eaton business.
 - 3. EGS/Appleton Electric.
 - 4. Erickson Electrical Equipment Company.
 - 5. FSR Inc.
 - 6. Hoffman; a brand of nVent.
 - 7. Hubbell Incorporated.
 - 8. Hubbell Incorporated; Wiring Device-Kellems.
 - 9. Kraloy.
 - 10. Milbank Manufacturing Co.

11. MonoSystems, Inc.
 12. Oldcastle Enclosure Solutions.
 13. O- /Gedney; a brand of Emerson Industrial Automation.
 14. Plasti-Bond.
 15. RACO; Hubbell.
 16. Spring City Electrical Manufacturing Company.
 17. Stahlin Non-Metallic Enclosures.
 18. Thomas & Betts Corporation; A Member of the ABB Group.
 19. Topa Electric; a division of Topa Lighting Corp.
 20. Wiremold / Legrand.
- B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.
- F. Metal Floor Boxes:
1. Material: Cast metal.
 2. Type: Fully adjustable.
 3. Shape: Rectangular.
 4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- G. All exterior boxes shall be anti-corrosive and suitable for marine environment.
- H. Nonmetallic Floor Boxes: Nonadjustable, rectangular.
1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- I. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.
- J. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb.
1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- K. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- L. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

- M. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- N. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.
- O. Gangable boxes are allowed.
- P. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
 - 1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
 - 2. Nonmetallic Enclosures: Fiberglass.
 - 3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.
- Q. Cabinets:
 - 1. NEMA 250, Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
 - 2. Hinged door in front cover with flush latch and concealed hinge.
 - 3. Key latch to match panelboards.
 - 4. Metal barriers to separate wiring of different systems and voltage.
 - 5. Accessory feet where required for freestanding equipment.
 - 6. Nonmetallic cabinets shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.

2.7 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

- A. General Requirements for Handholes and Boxes:
 - 1. Boxes and handholes for use in underground systems shall be designed and identified as defined in the CEC, for intended location and application.
 - 2. Boxes installed in wet areas shall be listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Oldcastle Enclosure Solutions.
 - d. Oldcastle Precast, Inc.
 - e. Quaite: Hubbell Power Systems, Inc.

2. Standard: Comply with SCTE 77.
3. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
6. Cover Legend: Molded lettering, "ELECTRIC".
7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
8. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of polymer concrete.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armorcast Products Company.
 - b. NewBasis.
 - c. Nordic Fiberglass, Inc.
 - d. Oldcastle Enclosure Solutions.
 - e. Oldcastle Enclosure Solutions.
 - f. Oldcastle Precast, Inc.
 - g. Qua[®]ite: Hubbell Power Systems, Inc.
2. Standard: Comply with SCTE 77.
3. Color of Frame and Cover: Gray.
4. Configuration: Designed for flush burial with open bottom unless otherwise indicated.
5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
7. Cover Legend: Molded lettering, "ELECTRIC".
8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
9. Handholes 12 Inches Wide by 24 Inches Long and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

2.8 SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES

- A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
1. Tests of materials shall be performed by an independent testing agency.
 2. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 3. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012 and traceable to NIST standards.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: EMT.
3. Underground Conduit: RNC, Type EPC-80-PVC, concrete encased.
4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed, Not Subject to Severe Physical Damage: RNC identified for such use.
3. Exposed and Subject to Severe Physical Damage: GRC. Raceway locations include the following:
 - a. Loading dock.
 - b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
 - c. Mechanical rooms.
 - d. Gymnasiums.
4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
6. Damp or Wet Locations: GRC.
7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
3. EMT: Use compression, cast-metal fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

- E. Install nonferrous conduit or tubing for circuits operating above 60 H₂O. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.
- F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
- G. Install surface raceways only where indicated on Drawings.
- H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- B. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with the CEC limitations for types of raceways allowed in specific occupancies and number of floors.
- C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.
- D. Do not fasten conduits onto the bottom side of a metal deck roof.
- E. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.
- F. Complete raceway installation before starting conductor installation.
- G. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.
- I. Make bends in raceway using large-radius preformed ells. Field bending shall be according to the CEC minimum radii requirements. Use only equipment specifically designed for material and size involved.
- J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- K. Support conduit within 12 inches of enclosures to which attached.
- L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.
 2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.
 3. Arrange raceways to keep a minimum of 2 inch of concrete cover in all directions.
 4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.
 5. Change from ENT to GRC before rising above floor.
- M. Stub-Ups to Above Recessed Ceilings:
1. Use EMT, IMC, or RMC for raceways.
 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- N. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.
- O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.
- P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
- Q. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.
- R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- S. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- T. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.
- U. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.
- V. Surface Raceways:
1. Install surface raceway with a minimum 2-inch radius control at bend points.
 2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section.

Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

- W. Install raceway sealing fittings at accessible locations according to the CEC and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings according to the CEC.
- X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
 - 1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
 - 2. Where an underground service raceway enters a building or structure.
 - 3. Conduit extending from interior to exterior of building.
 - 4. Conduit extending into pressurized duct and equipment.
 - 5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
 - 6. Where otherwise required by the CEC.
- Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

. Expansion-Joint Fittings:

- 1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC and EMT conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
- 2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
 - a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
 - b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
 - c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
 - d. Attics: 135 deg F temperature change.
- 3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
- 4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
- 5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

- AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 36 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.
 - 1. Use LFMC in damp or wet locations subject to severe physical damage.
 - 2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.
- BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- CC. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- EE. Locate boxes so that cover or plate will not span different building finishes.
- FF. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.
- HH. Set metal floor boxes level and flush with finished floor surface.
- II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

- A. Direct-Buried Conduit:
 - 1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Trenching and Backfill" for pipe less than 6 inches in nominal diameter.
 - 2. Install backfill as specified in Section 312000 "Trenching and Backfill."
 - 3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Trenching and Backfill."
 - 4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
 - a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
 - b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.
- D. Install handholes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.
- F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 - 2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION 260533

SECTION 260543 - UNDERGROUND DUCTS AND RACEWAYS FOR ELECTRICAL SYSTEMS

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. Metal conduits and fittings, including GRC and PVC-coated steel conduit.
 - 2. Rigid nonmetallic duct.
 - 3. Duct accessories.
 - 4. Precast concrete handholes.
 - 5. Polymer concrete handholes and boxes with polymer concrete cover.
 - 6. Fiberglass handholes and boxes with polymer concrete cover.
 - 7. Fiberglass handholes and boxes.
 - 8. High-density plastic boxes.
 - 9. Precast manholes.
 - 10. Cast-in-place manholes.
 - 11. Utility structure accessories.

1.3 DEFINITIONS

- A. Direct Buried: Duct or a duct bank that is buried in the ground, without any additional casing materials such as concrete.
- B. Duct: A single duct or multiple ducts. Duct may be either installed singly or as component of a duct bank.
- C. Duct Bank:
 - 1. Two or more ducts installed in parallel, with or without additional casing materials.
 - 2. Multiple duct banks.
- D. GRC: Galvanized rigid (steel) conduit.
- E. Trafficways: Locations where vehicular or pedestrian traffic is a normal course of events.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include duct-bank materials, including spacers and miscellaneous components.
2. Include duct, conduits, and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
3. Include accessories for manholes, handholes, boxes, and other utility structures.
4. Include underground-line warning tape.
5. Include warning planks.

B. Shop Drawings:

1. Precast or Factory-Fabricated Underground Utility Structures:

- a. Include plans, elevations, sections, details, attachments to other work, and accessories.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include reinforcement details.
- d. Include frame and cover design and manhole chimneys.
- e. Include ladder details.
- f. Include grounding details.
- g. Include dimensioned locations of cable rack inserts, pulling-in and lifting irons, and sumps.
- h. Include joint details.

2. Factory-Fabricated Handholes and Boxes Other Than Precast Concrete:

- a. Include dimensioned plans, sections, and elevations, and fabrication and installation details.
- b. Include duct entry provisions, including locations and duct sizes.
- c. Include cover design.
- d. Include grounding details.
- e. Include dimensioned locations of cable rack inserts, and pulling-in and lifting irons.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: For duct and duct bank. Show duct profiles and coordination with other utilities and underground structures.

1. Include plans and sections, drawn to scale, and show bends and locations of expansion fittings.
2. Drawings shall be signed and sealed by a qualified professional engineer.

B. Qualification Data: For professional engineer and testing agency responsible for testing nonconcrete handholes and boxes.

- C. Product Certificates: For concrete and steel used in precast concrete manholes and handholes, as required by ASTM C858.
- D. Source quality-control reports.
- E. Field quality-control reports.

1.6 MAINTENANCE MATERIALS SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
- B. Furnish cable-support stanchions, arms, insulators, and associated fasteners in quantities equal to 5 percent of quantity of each item installed.

1.7 QUALITY ASSURANCE

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

1.8 FIELD CONDITIONS

- A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions, and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than ten days in advance of proposed interruption of electrical service.
 - 2. Do not proceed with interruption of electrical service without Owner's written permission.
- B. Ground Water: Assume ground-water level is 36 inches below ground surface unless a higher water table is noted on Drawings.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND FITTINGS

- A. GRC: Comply with ANSI C80.1 and UL 6.
- B. Coated Steel Conduit: PVC-coated GRC.
 - 1. Comply with NEMA RN 1.
 - 2. Coating Thickness: 0.040 inch, minimum.

- C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFC Cable Systems; a part of Atkore International.
 2. Allied Tube & Conduit; a part of Atkore International.
 3. Anamet Electrical, Inc.
 4. Calconduit.
 5. Electri-Flex Company.
 6. FSR Inc.
 7. Korkap.
 8. NEC, Inc.
 9. Opti-Com Manufacturing Network, Inc (OMNI).
 10. O- /Gedney; a brand of Emerson Industrial Automation.
 11. Perma-Cote.
 12. Picoma Industries, Inc.
 13. Plasti-Bond.
 14. Republic Conduit.
 15. Southwire Company.
 16. Thomas & Betts Corporation; A Member of the ABB Group.
 17. Topa Electric; a division of Topa Lighting Corp.
 18. Western Tube and Conduit Corporation.
 19. Wheatland Tube Company.
- D. Listed and labeled as defined in the CEC, by a nationally recognized testing laboratory, and marked for intended location and application.

2.2 RIGID NONMETALLIC DUCT

- A. Underground Plastic Utilities Duct: Type EPC-80-PVC RNC, complying with NEMA TC 2 and UL 651, with matching fittings complying with NEMA TC 3 by same manufacturer as duct.
- B. Underground Plastic Utilities Duct: Type DB-120 PVC RNC, complying with NEMA TC 6 & 8 and ASTM F512 for direct burial, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- C. Underground Plastic Utilities Duct: Type EB-20 PVC RNC, complying with NEMA TC 6 & 8, ASTM F512, and UL 651, with matching fittings complying with NEMA TC 9 by same manufacturer as duct.
- D. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. ARNCO Corp.
 2. Beck Manufacturing.
 3. CANTEX INC.
 4. CertainTeed Corporation.
 5. Condux International, Inc.
 6. Crown Line Plastics.

7. ElecSys, Inc.
8. Electri-Flex Company.
9. Endot Industries Inc.
10. IPEX USA LLC.
11. Lamson & Sessions.
12. Manhattan/CDT.
13. National Pipe & Plastics.
14. Opti-Com Manufacturing Network, Inc (OMNI).
15. Spiraduct/AFC Cable Systems, Inc.

- E. Listed and labeled as defined in the CEC, by a nationally recognized testing laboratory, and marked for intended location and application.
- F. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 DUCT ACCESSORIES

- A. Duct Spacers: Factory-fabricated, rigid, PVC interlocking spacers; sized for type and size of duct with which used, and selected to provide minimum duct spacing indicated while supporting duct during concreting or backfilling.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Allied Tube & Conduit; a part of Atkore International.
 - b. CANTEX INC.
 - c. Carlton; a brand of Thomas & Betts Corporation.
 - d. IPEX USA LLC.
 - e. PenCell Plastics.
 - f. Underground Devices, Inc.
- B. Underground-Line Warning Tape: Comply with requirements for underground-line warning tape specified in Section 260553 "Identification for Electrical Systems."
- C. Concrete Warning Planks: Nominal 12 by 24 by 3 inches in size, manufactured from 6000-psi concrete.
1. Color: Red dye added to concrete during batching.
 2. Mark each plank with "ELECTRIC" in 2-inch-high, 3/8-inch-deep letters.

2.4 PRECAST CONCRETE HANDHOLES AND BOXES

- A. Description: Factory-fabricated, reinforced-concrete, monolithically poured walls and bottom unless open-bottom enclosures are indicated. Frame and cover shall form top of enclosure and shall have load rating consistent with that of handhole or box.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Christy Concrete Products.
 2. Elmhurst-Chicago Stone Co.
 3. Oldcastle Precast, Inc.
 4. Rinker Group, Ltd.
 5. Riverton Concrete Products.
 6. Utility Concrete Products, LLC.
 7. Utility Vault Co.
 8. Wausau Tile Inc.
- C. Comply with ASTM C858 for design and manufacturing processes.
- D. Frame and Cover: Weatherproof cast-iron frame, with cast-iron cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- E. Frame and Cover: Weatherproof steel frame, with steel cover with recessed cover hook eyes and tamper-resistant, captive, cover-securing bolts.
- F. Frame and Cover: Weatherproof steel frame, with hinged steel access door assembly with tamper-resistant, captive, cover-securing bolts.
1. Cover Hinges: Concealed, with hold-open ratchet assembly.
 2. Cover Handle: Recessed.
- G. Frame and Cover: Weatherproof aluminum frame with hinged aluminum access door assembly with tamper-resistant, captive, cover-securing bolts.
1. Cover Hinges: Concealed, with hold-open ratchet assembly.
 2. Cover Handle: Recessed.
- H. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- I. Cover Legend: Molded lettering, "ELECTRIC."
- J. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- K. Extensions and Slabs: Designed to mate with bottom of enclosure. Same material as enclosure.
1. Extension shall provide increased depth of 12 inches.
 2. Slab: Same dimensions as bottom of enclosure, and arranged to provide closure.
- L. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.
- M. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
1. Splayed location.

2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or frames and covers of handholes, but close enough to corners to facilitate racking of cables on walls.
 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 4. Knockout panels shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 5. Knockout panels shall be 1-1/2 to 2 inches thick.
- N. Duct Entrances in Handhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
1. Type and size shall match fittings to duct to be terminated.
 2. Fittings shall align with elevations of approaching duct and be located near interior corners of handholes to facilitate racking of cable.
- O. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.
- 2.5 POLYMER CONCRETE HANDHOLES AND BOXES WITH POLYMER CONCRETE COVER
- A. Description: Molded of sand and aggregate, bound together with a polymer resin, and reinforced with steel or fiberglass or a combination of the two.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Armorcast Products Company.
 2. MacLean Highline.
 3. NewBasis.
 4. Oldcastle Enclosure Solutions.
 5. Quaite: Hubbell Power Systems, Inc.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- E. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- F. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- G. Cover Legend: Molded lettering, "ELECTRIC."

- H. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- I. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- J. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.6 FIBERGLASS HANDHOLES AND BOXES WITH POLYMER CONCRETE FRAME AND COVER

- A. Description: Sheet-molded, fiberglass-reinforced, polyester resin enclosure joined to polymer concrete top ring or frame.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Armorcast Products Company.
 - 2. Christy Concrete Products.
 - 3. NewBasis.
 - 4. Oldcastle Enclosure Solutions.
 - 5. Quaite: Hubbell Power Systems, Inc.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.7 FIBERGLASS HANDHOLES AND BOXES

- A. Description: Molded of fiberglass-reinforced polyester resin, with covers made of reinforced concrete.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Christy Concrete Products.
 - 2. MacLean Highline.
 - 3. Nordic Fiberglass, Inc.
 - 4. Oldcastle Enclosure Solutions.
 - 5. Quaite: Hubbell Power Systems, Inc.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.8 HIGH-DENSITY PLASTIC BOXES

- A. Description: Injection molded of HDPE or copolymer-polypropylene. Cover shall be made of polymer concrete.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Nordic Fiberglass, Inc.
 - 2. Oldcastle Enclosure Solutions.

3. PenCell Plastics.
 4. Qua^lite: Hubbell Power Systems, Inc.
- C. Standard: Comply with SCTE 77. Comply with tier requirements in "Underground Enclosure Application" Article.
- D. Color: Gray.
- E. Configuration: Units shall be designed for flush burial and have open bottom unless otherwise indicated.
- F. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
- G. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
- H. Cover Legend: Molded lettering, "ELECTRIC."
- I. Direct-Buried Wiring Entrance Provisions: Knockouts equipped with insulated bushings or end-bell fittings, selected to suit box material, sized for wiring indicated, and arranged for secure, fixed installation in enclosure wall.
- J. Duct Entrance Provisions: Duct-terminating fittings shall mate with entering duct for secure, fixed installation in enclosure wall.
- K. Handholes 12 inches wide by 24 inches long and larger shall have factory-installed inserts for cable racks and pulling-in irons.

2.9 PRECAST MANHOLES

- A. Description: One-piece units and units with interlocking mating sections, complete with accessories, hardware, and features.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Carder Concrete Products.
 2. Christy Concrete Products.
 3. Elmhurst-Chicago Stone Co.
 4. Oldcastle Precast, Inc.
 5. Rinker Group, Ltd.
 6. Riverton Concrete Products.
 7. Utility Concrete Products, LLC.
 8. Utility Vault Co.
 9. Wausau Tile Inc.
- C. Comply with ASTM C858.

- D. Structural Design Loading: Comply with requirements in "Underground Enclosure Application" Article.
- E. Knockout Panels: Precast openings in walls, arranged to match dimensions and elevations of approaching duct, plus an additional 12 inches vertically and horizontally to accommodate alignment variations.
 - 1. Splayed location.
 - 2. Knockout panels shall be located no less than 6 inches from interior surfaces of walls, floors, or roofs of manholes, but close enough to corners to facilitate racking of cables on walls.
 - 3. Knockout panel opening shall have cast-in-place, welded-wire fabric reinforcement for field cutting and bending to tie in to concrete envelopes of duct.
 - 4. Knockout panel shall be framed with at least two additional No. 3 steel reinforcing bars in concrete around each opening.
 - 5. Knockout panels shall be 1-1/2 to 2 inches thick.
- F. Duct Entrances in Manhole Walls: Cast end-bell or duct-terminating fitting in wall for each entering duct.
 - 1. Type and size shall match fittings to duct to be terminated.
 - 2. Fittings shall align with elevations of approaching duct and be located near interior corners of manholes to facilitate racking of cable.
- G. Ground Rod Sleeve: Provide a 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the duct entering the structure.
- H. Joint Sealant: Asphaltic-butyl material with adhesion, cohesion, flexibility, and durability properties necessary to withstand maximum hydrostatic pressures at the installation location with the ground-water level at grade.

2.10 UTILITY STRUCTURE ACCESSORIES

- A. Accessories for Utility Structures: Utility equipment and accessory items used for utility structure access and utility support, listed and labeled for intended use and application.
- B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. BILCO Company (The).
 - 2. Campbell Foundry Company.
 - 3. Carder Concrete Products.
 - 4. Christy Concrete Products.
 - 5. EJ.
 - 6. Elmhurst-Chicago Stone Co.
 - 7. McKinley Iron Works, Inc.
 - 8. Neenah Foundry Company.
 - 9. NewBasis.
 - 10. Oldcastle Precast, Inc.

11. Osburn Associates, Inc.
 12. Pennsylvania Insert Corporation.
 13. Qua^lite: Hubbell Power Systems, Inc.
 14. Rinker Group, Ltd.
 15. Riverton Concrete Products.
 16. Underground Devices, Inc.
 17. Utility Concrete Products, LLC.
 18. Utility Vault Co.
 19. Wausau Tile Inc.
- C. Manhole Frames, Covers, and Chimney Components: Comply with structural design loading specified for manhole.
1. Frame and Cover: Weatherproof, gray cast iron complying with ASTM A48/A48M, Class 30B with milled cover-to-frame bearing surfaces; diameter, 29 inches.
 - a. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
 - b. Special Covers: Recess in face of cover designed to accept finish material in paved areas.
 2. Cover Legend: Cast in. Selected to suit system.
 - a. Legend: "ELECTRIC-LV" for duct systems with power wires and cables for systems operating at 600 V and less.
 - b. Legend: "ELECTRIC-HV" for duct systems with medium-voltage cables.
 3. Manhole Chimney Components: Precast concrete rings with dimensions matched to those of roof opening.
 - a. Mortar for Chimney Ring and Frame and Cover Joints: Comply with ASTM C270, Type M, except for quantities less than 2.0 cu. ft. where packaged mix complying with ASTM C387, Type M, may be used.
- D. Manhole Sump Frame and Grate: ASTM A48/A48M, Class 30B, gray cast iron.
- E. Pulling Eyes in Concrete Walls: Eyebolt with reinforcing-bar fastening insert, 2-inch-diameter eye, and 1-by-4-inch bolt.
1. Working Load Embedded in 6-Inch, 4000-psi Concrete: 13,000-lbf minimum tension.
- F. Pulling Eyes in Nonconcrete Walls: Eyebolt with reinforced fastening, 1-1/4-inch-diameter eye, rated 2500-lbf minimum tension.
- G. Pulling-in and Lifting Irons in Concrete Floors: 7/8-inch-diameter, hot-dip galvanized, bent steel rod; stress relieved after forming; and fastened to reinforcing rod. Exposed triangular opening.
1. Ultimate Yield Strength: 40,000-lbf shear and 60,000-lbf tension.

- H. Bolting Inserts for Concrete Utility Structure Cable Racks and Other Attachments: Flared, threaded inserts of noncorrosive, chemical-resistant, nonconductive thermoplastic material; 1/2-inch ID by 2-3/4 inches deep, flared to 1-1/4 inches minimum at base.
 - 1. Tested Ultimate Pullout Strength: 12,000 lbf minimum.
- I. Ground Rod Sleeve: 3-inch PVC sleeve in manhole floors 2 inches from the wall adjacent to, but not underneath, the ducts routed from the facility.
- J. Expansion Anchors for Installation after Concrete Is Cast: zinc-plated, carbon-steel-wedge type with stainless-steel expander clip with 1/2-inch bolt, 5300-lbf rated pullout strength, and minimum 6800-lbf rated shear strength.
- K. Cable Rack Assembly: Steel, hot-rolled galvanized, except insulators.
 - 1. Stanchions: T-section or channel with provisions to connect to other sections or channels to form a continuous unit; 1-1/2 inches in width by nominal 24 inches long; punched with 14 hook holes on 1-1/2-inch centers for cable-arm attachment.
 - 2. Arms: 1-1/2 inches wide, lengths ranging from 3 inches with 450-lb minimum capacity to 18 inches with 250-lb minimum capacity. Arms shall have slots along full length for cable ties and be arranged for secure mounting in horizontal position at any vertical location on stanchions.
 - 3. Insulators: High-gloss, wet-process porcelain arranged for mounting on cable arms.
- L. Duct-Sealing Compound: Nonhardening, safe for contact with human skin, not deleterious to cable insulation, and workable at temperatures as low as 35 deg F. Capable of withstanding temperature of 300 deg F without slump and adhering to clean surfaces of plastic ducts, metallic conduit, conduit and duct coatings, concrete, masonry, lead, cable sheaths, cable jackets, insulation materials, and common metals.
- M. Portable Manhole Ladders: UL-listed, heavy-duty fiberglass specifically designed for portable use for access to electrical manholes. Minimum length equal to distance from deepest manhole floor to grade plus 36 inches. One required.
- N. Cover Hooks: Heavy duty, designed for lifts 60 lbf and greater. Two required.

2.11 SOURCE QUALITY CONTROL

- A. Test and inspect precast concrete utility structures according to ASTM C1037.
- B. Nonconcrete Handhole and Pull-Box Prototype Test: Test prototypes of manholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.
 - 1. Tests of materials shall be performed by an independent testing agency.
 - 2. Strength tests of complete boxes and covers shall be by an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.
 - 3. Testing machine pressure gages shall have current calibration certification, complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Coordinate layout and installation of duct, duct bank, manholes, handholes, and boxes with final arrangement of other utilities, site grading, and surface features as determined in the field. Notify Architect if there is a conflict between areas of excavation and existing structures or archaeological sites to remain.
- B. Coordinate elevations of duct and duct-bank entrances into manholes, handholes, and boxes with final locations and profiles of duct and duct banks, as determined by coordination with other utilities, underground obstructions, and surface features. Revise locations and elevations as required to suit field conditions and to ensure that duct and duct bank will drain to manholes and handholes, and as approved by Architect.
- C. Clear and grub vegetation to be removed, and protect vegetation to remain according to Section 311000 "Site Clearing." Remove and stockpile topsoil for reapplication according to Section 311000 "Site Clearing."

3.2 UNDERGROUND DUCT APPLICATION

- A. Duct for Electrical Cables More Than 600 V: Type EPC-80-PVC RNC, concrete-encased unless otherwise indicated.
- B. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, concrete-encased unless otherwise indicated.
- C. Duct for Electrical Feeders 600 V and Less: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- D. Duct for Electrical Branch Circuits: Type EPC-80-PVC RNC, direct-buried unless otherwise indicated.
- E. Bored Underground Duct: Type EPEC-80-HDPE unless otherwise indicated.
- F. Underground Ducts Crossing Paved Paths Walks and Driveways and Roadways: Type EPC-40 PVC RNC, encased in reinforced concrete.
- G. Stub-ups: Concrete-encased PVC-coated GRC.

3.3 UNDERGROUND ENCLOSURE APPLICATION

- A. Handholes and Boxes for 600 V and Less:
 - 1. Units in Roadways and Other Deliberate Traffic Paths: Precast concrete. AASHTO HB 17, H-20 structural load rating.

2. Units in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Nondeliberate Loading by Heavy Vehicles: Precast concrete, AASHTO HB 17, H-20 structural load rating.
3. Units in Sidewalk and Similar Applications with a Safety Factor for Nondeliberate Loading by Vehicles: Precast concrete, AASHTO HB 17, H-10 structural load rating.
4. Units Subject to Light-Duty Pedestrian Traffic Only: Fiberglass-reinforced polyester resin, structurally tested according to SCTE 77 with 3000-lbf vertical loading.
5. Cover design load shall not exceed the design load of the handhole or box.

B. Manholes: Precast concrete.

1. Units Located in Roadways and Other Deliberate Traffic Paths by Heavy or Medium Vehicles: H-20 structural load rating according to AASHTO HB 17.
2. Units Not Located in Deliberate Traffic Paths by Heavy or Medium Vehicles: H-10 load rating according to AASHTO HB 17.

3.4 EARTHWORK

- A. Excavation and Backfill: Comply with Section 312000 "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.
- B. Restoration: Replace area after construction vehicle traffic in immediate area is complete.
- C. Restore surface features at areas disturbed by excavation, and re-establish original grades unless otherwise indicated. Replace removed sod immediately after backfilling is completed.
- D. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching. Comply with Section 329200 "Turf Seeding and Section 329300 "Plants."

3.5 DUCT AND DUCT-BANK INSTALLATION

- A. Where indicated on Drawings, install duct, spacers, and accessories into the duct-bank configuration shown. Duct installation requirements in this Section also apply to duct bank.
- B. Install duct according to NEMA TCB 2.
- C. Slope: Pitch duct a minimum slope of 1:300 down toward manholes and handholes and away from buildings and equipment. Slope duct from a high point between two manholes, to drain in both directions.
- D. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 48 inches, both horizontally and vertically, at other locations unless otherwise indicated.
 1. Duct shall have maximum of two 90 degree bends or the total of all bends shall be no more 180 degrees between pull points.

- E. Joints: Use solvent-cemented joints in duct and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent duct do not lie in same plane.
- F. Installation Adjacent to High-Temperature Steam Lines: Where duct is installed parallel to underground steam lines, perform calculations showing the duct will not be subject to environmental temperatures above 40 deg C. Where environmental temperatures are calculated to rise above 40 deg C, and anywhere the duct crosses above an underground steam line, install insulation blankets listed for direct burial to isolate the duct bank from the steam line.
- G. End Bell Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use end bells, spaced approximately 10 inches o.c. for 5-inch duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to end-bell spacing 10 feet from the end bell, without reducing duct slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line direct-buried duct with calculated expansion of more than 3/4 inch.
 - 3. Grout end bells into structure walls from both sides to provide watertight entrances.
- H. Terminator Entrances to Manholes and Concrete and Polymer Concrete Handholes: Use manufactured, cast-in-place duct terminators, with entrances into structure spaced approximately 6 inches o.c. for 4-inch duct, and vary proportionately for other duct sizes.
 - 1. Begin change from regular spacing to terminator spacing 10 feet from the terminator, without reducing duct line slope and without forming a trap in the line.
 - 2. Expansion and Deflection Fittings: Install an expansion and deflection fitting in each duct in the area of disturbed earth adjacent to manhole or handhole. Install an expansion fitting near the center of all straight line duct with calculated expansion of more than 3/4 inch.
- I. Building Wall Penetrations: Make a transition from underground duct to GRC at least 10 feet outside the building wall, without reducing duct line slope away from the building and without forming a trap in the line. Use fittings manufactured for RNC-to-GRC transition. Install GRC penetrations of building walls as specified in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."
- J. Sealing: Provide temporary closure at terminations of duct with pulled cables. Seal spare duct at terminations. Use sealing compound and plugs to withstand at least 15-psig hydrostatic pressure.
- K. Pulling Cord: Install 200-lbf-test nylon cord in empty ducts.
 - 1. Excavate trench bottom to provide firm and uniform support for duct. Prepare trench bottoms as specified in Section 312000 "Trenching" for pipes less than 6 inches in nominal diameter.
 - 2. Width: Excavate trench 12 inches wider than duct on each side.

3. Depth: Install so top of duct envelope is at least 24 inches below finished grade in areas not subject to deliberate traffic, and at least 30 inches below finished grade in deliberate traffic paths for vehicles unless otherwise indicated.
4. Support duct on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
5. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to duct to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
6. Elbows: Use manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct run.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.
7. Reinforcement: Reinforce concrete-encased duct where crossing disturbed earth and where indicated. Arrange reinforcing rods and ties without forming conductive or magnetic loops around ducts or duct groups.
8. Forms: Use walls of trench to form side walls of duct bank where soil is self-supporting and concrete envelope can be poured without soil inclusions; otherwise, use forms.
9. Concrete Cover: Install a minimum of 3 inches of concrete cover between edge of duct to exterior envelope wall, 2 inches between duct of like services, and 4 inches between power and communications ducts.
10. Concreting Sequence: Pour each run of envelope between manholes or other terminations in one continuous operation.
 - a. Start at one end and finish at the other, allowing for expansion and contraction of duct as its temperature changes during and after the pour. Use expansion fittings installed according to manufacturer's written instructions, or use other specific measures to prevent expansion-contraction damage.
 - b. If more than one pour is necessary, terminate each pour in a vertical plane and install 3/4-inch reinforcing-rod dowels extending a minimum of 18 inches into concrete on both sides of joint near corners of envelope.

11. Pouring Concrete: Comply with requirements in "Concrete Placement" Article in Section 033000 "Cast-in-Place Concrete." Place concrete carefully during pours to prevent voids under and between duct and at exterior surface of envelope. Do not allow a heavy mass of concrete to fall directly onto ducts. Allow concrete to flow around duct and rise up in middle, uniformly filling all open spaces. Do not use power-driven agitating equipment unless specifically designed for duct-installation application.

L. Direct-Buried Duct and Duct Bank:

1. Excavate trench bottom to provide firm and uniform support for duct. Comply with requirements in Section 312000 "Trenching" for preparation of trench bottoms for pipes less than 6 inches in nominal diameter.
2. Width: Excavate trench 12 inches wider than duct on each side.
3. Width: Excavate trench 3 inches wider than duct on each side.
4. Depth: Install top of duct at least 36 inches below finished grade unless otherwise indicated.
5. Set elevation of bottom of duct bank below frost line.
6. Support ducts on duct spacers coordinated with duct size, duct spacing, and outdoor temperature.
7. Spacer Installation: Place spacers close enough to prevent sagging and deforming of duct, with not less than five spacers per 20 feet of duct. Place spacers within 24 inches of duct ends. Stagger spacers approximately 6 inches between tiers. Secure spacers to earth and to ducts to prevent floating during concreting. Tie entire assembly together using fabric straps; do not use tie wires or reinforcing steel that may form conductive or magnetic loops around ducts or duct groups.
8. Install duct with a minimum of 3 inches between ducts for like services and 6 inches between power and communications duct.
9. Elbows: Install manufactured duct elbows for stub-ups, at building entrances, and at changes of direction in duct direction unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
10. Install manufactured GRC elbows for stub-ups, at building entrances, and at changes of direction in duct.
 - a. Couple RNC duct to GRC with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
 - b. Stub-ups to Outdoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of base. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished floor and minimum 3 inches from conduit side to edge of slab.
 - c. Stub-ups to Indoor Equipment: Extend concrete-encased GRC horizontally a minimum of 60 inches from edge of wall. Install insulated grounding bushings on terminations at equipment.
 - 1) Stub-ups shall be minimum 4 inches above finished floor and no less than 3 inches from conduit side to edge of slab.

11. After installing first tier of duct, backfill and compact. Start at tie-in point and work toward end of duct run, leaving ducts at end of run free to move with expansion and contraction as temperature changes during this process. Repeat procedure after placing each tier. After placing last tier, hand place backfill to 4 inches over duct and hand tamp. Firmly tamp backfill around ducts to provide maximum supporting strength. Use hand tamper only. After placing controlled backfill over final tier, make final duct connections at end of run and complete backfilling with normal compaction. Comply with requirements in Section 312000 "Earth Moving" for installation of backfill materials.

- a. Place minimum 3 inches of sand as a bed for duct. Place sand to a minimum of 6 inches above top level of duct.
- b. Place minimum 6 inches of engineered fill above concrete encasement of duct.

M. Warning Planks: Bury warning planks approximately 12 inches above direct-buried duct, placing them 24 inches o.c. Align planks along the width and along the centerline of duct or duct bank. Provide an additional plank for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional planks 12 inches apart, horizontally.

N. Underground-Line Warning Tape: Bury conducting underground line specified in Section 260553 "Identification for Electrical Systems" no less than 12 inches above all concrete-encased duct and duct banks and approximately 12 inches below grade. Align tape parallel to and within 3 inches of centerline of duct bank. Provide an additional warning tape for each 12-inch increment of duct-bank width over a nominal 18 inches. Space additional tapes 12 inches apart, horizontally.

3.6 INSTALLATION OF CONCRETE MANHOLES, HANDHOLES, AND BOXES

A. Cast-in-Place Manhole Installation:

1. Finish interior surfaces with a smooth-troweled finish.
2. Knockouts for Future Duct Connections: Form and pour concrete knockout panels 1-1/2 to 2 inches thick, arranged as indicated.
3. Comply with requirements in Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete, formwork, and reinforcement.

B. Precast Concrete Handhole and Manhole Installation:

1. Comply with ASTM C891 unless otherwise indicated.
2. Install units level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances.
3. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevations:

1. Manhole Roof: Install with rooftop at least 15 inches below finished grade.
2. Manhole Frame: In paved areas and trafficways, set frames flush with finished grade. Set other manhole frames 1 inch above finished grade.

3. Install handholes with bottom below frost line, below grade.
 4. Handhole Covers: In paved areas and trafficways, set surface flush with finished grade. Set covers of other handholes 1 inch above finished grade.
 5. Where indicated, cast handhole cover frame integrally with handhole structure.
- D. Drainage: Install drains in bottom of manholes where indicated. Coordinate with drainage provisions indicated.
- E. Manhole Access: Circular opening in manhole roof; sized to match cover size.
1. Manholes with Fixed Ladders: Offset access opening from manhole centerlines to align with ladder.
 2. Install chimney, constructed of precast concrete collars and rings, to support cast-iron frame to connect cover with manhole roof opening. Provide moisture-tight masonry joints and waterproof grouting for frame to chimney.
- F. Hardware: Install removable hardware, including pulling eyes, cable stanchions, and cable arms, and insulators, as required for installation and support of cables and conductors and as indicated.
- G. Field-Installed Bolting Anchors in Manholes and Concrete Handholes: Do not drill deeper than 3-7/8 inches for manholes and 2 inches for handholes, for anchor bolts installed in the field. Use a minimum of two anchors for each cable stanchion.

3.7 INSTALLATION OF HANDHOLES AND BOXES OTHER THAN PRECAST CONCRETE

- A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting duct, to minimize bends and deflections required for proper entrances. Use box extension if required to match depths of duct, and seal joint between box and extension as recommended by manufacturer.
- B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.
- C. Elevation: In paved areas and trafficways, set cover flush with finished grade. Set covers of other handholes 1 inch above finished grade.
- D. Install handholes and boxes with bottom below frost line, below grade.
- E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in enclosure.
- F. Field cut openings for duct according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

- G. For enclosures installed in asphalt paving and subject to occasional, nondeliberate, heavy-vehicle loading, form and pour a concrete ring encircling, and in contact with, enclosure and with top surface screeded to top of box cover frame. Bottom of ring shall rest on.
 - 1. Concrete: 3000 psi, 28-day strength, complying with Section 033000 "Cast-in-Place Concrete," with a troweled finish.
 - 2. Dimensions: 10 inches wide by 12 inches deep.

3.8 GROUNDING

- A. Ground underground ducts and utility structures according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.9 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
 - 1. Demonstrate capability and compliance with requirements on completion of installation of underground duct, duct bank, and utility structures.
 - 2. Pull solid aluminum or wood test mandrel through duct to prove joint integrity and adequate bend radii, and test for out-of-round duct. Provide a minimum 12-inch-long mandrel equal to duct size minus 1/4 inch. If obstructions are indicated, remove obstructions and retest.
- B. Correct deficiencies and retest as specified above to demonstrate compliance.
- C. Prepare test and inspection reports.

3.10 CLEANING

- A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of duct until duct cleaner indicates that duct is clear of dirt and debris. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout ducts.
- B. Clean internal surfaces of manholes, including sump.
 - 1. Sweep floor, removing dirt and debris.
 - 2. Remove foreign material.

END OF SECTION 260543

SECTION 260544 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
 - 2. Sleeve-seal systems.
 - 3. Sleeve-seal fittings.
 - 4. Grout.
 - 5. Silicone sealants.

- B. Related Requirements:

- 1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

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

PART 2 - PRODUCTS

2.1 SLEEVES

- A. Wall Sleeves:

- 1. Steel Pipe Sleeves: ASTM A53/A53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
 - 2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

- B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.
- C. PVC-Pipe Sleeves: ASTM D1785, Schedule 40.
- D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.
- E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.
- F. Sleeves for Rectangular Openings:
 - 1. Material: Galvanized sheet steel.
 - 2. Minimum Metal Thickness:
 - a. For sleeve cross-section rectangle perimeter less than 50 inches and with no side larger than 16 inches, thickness shall be 0.052 inch.
 - b. For sleeve cross-section rectangle perimeter 50 inches or more and one or more sides larger than 16 inches, thickness shall be 0.138 inch.

2.2 SLEEVE-SEAL SYSTEMS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Advance Products & Systems, Inc.
 - b. BWM Company.
 - c. CALPICO, Inc.
 - d. Flexicraft Industries.
 - e. Metraflex Company (The).
 - f. Pipeline Seal and Insulator, Inc.
 - g. Proco Products, Inc.
 - 2. Sealing Elements: Nitrile (Buna N) rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
 - 3. Pressure Plates: Carbon steel.
 - 4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

- A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. HOLDRITE.

2.4 GROUT

- A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.
- B. Standard: ASTM C1107/C1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.
- C. Design Mix: 5000-psi, 28-day compressive strength.
- D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

- A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.
 1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.
- B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

- A. Comply with NECA 1.
- B. Comply with NEMA VE 2 for cable tray and cable penetrations.
- C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
 1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
 - a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

- b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
 - 2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.
 - 4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.
 - 5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches above finished floor level. Install sleeves during erection of floors.
- D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
- 1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
 - 2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.
- E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.
- F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
- G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

- A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
- B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

- A. Install sleeve-seal fittings in new walls and slabs as they are constructed.
- B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

- C. Secure nailing flanges to concrete forms.
- D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION 260544

SECTION 260548.16 - SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

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. Restraint channel bracings.
2. Restraint cables.
3. Seismic-restraint accessories.
4. Mechanical anchor bolts.
5. Adhesive anchor bolts.

- B. Related Requirements:

1. Section 260529 "Hangers and Supports for Electrical Systems" for commonly used electrical supports and installation requirements.

1.3 ACTION SUBMITTALS

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

1. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
 - a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
 - b. Annotate to indicate application of each product submitted and compliance with requirements.

- B. Delegated-Design Submittal: For each seismic-restraint device.

1. Include design calculations and details for selecting seismic restraints complying with performance requirements, design criteria, and analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Design Calculations: Calculate static and dynamic loading caused by equipment weight, operation, and seismic and wind forces required to select seismic and wind restraints and for designing vibration isolation bases.

- a. Coordinate design calculations with wind load calculations required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
3. Seismic- and Wind-Restraint Details:
 - a. Design Analysis: To support selection and arrangement of seismic and wind restraints. Include calculations of combined tensile and shear loads.
 - b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
 - c. Coordinate seismic-restraint and vibration isolation details with wind-restraint details required for equipment mounted outdoors. Comply with requirements in other Sections for equipment mounted outdoors.
 - d. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Show coordination of seismic bracing for electrical components with other systems and equipment in the vicinity, including other supports and seismic restraints. Electrical components include:
 1. Control and monitoring panels.
 2. Generators.
 3. Luminaires.
 4. Motor control centers.
 5. Panelboards.
 6. Photovoltaic system components.
 7. Substations.
 8. Switchboards.
 9. Switchgear.
 10. Transformers.
 11. Unit substations.
- B. Qualification Data: For professional engineer and testing agency.
- C. Welding certificates.
- D. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated and that is acceptable to authorities having jurisdiction.

- B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.
- C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis. They shall bear anchorage preapproval from OSHPD in addition to preapproval, showing maximum seismic-restraint ratings, by ICC-ES or another agency acceptable to authorities having jurisdiction. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) that support seismic-restraint designs must be signed and sealed by a qualified professional engineer.
- E. Comply with the CEC.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Wind-Restraint Loading:
 - 1. Basic Wind Speed: 102 MPH.
 - 2. Building Classification Category: III.
 - 3. Minimum 10 lb/sq. ft. multiplied by maximum area of component projected on vertical plane normal to wind direction and 45 degrees either side of normal.
- B. Seismic-Restraint Loading:
 - 1. Site Class as Defined in the IBC: D.
 - 2. Assigned Seismic Use Group or Building Category as Defined in the IBC: III.
 - a. Component Importance Factor: 1.5.
 - b. Component Response Modification Factor: 2.5.
 - c. Component Amplification Factor: 2.5.
 - 3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 0.954
 - 4. Design Spectral Response Acceleration at 1.0-Second Period: 0.616.

2.2 RESTRAINT CHANNEL BRACINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. B-line, an Eaton business.
 - 2. Hilti, Inc.
 - 3. Mason Industries, Inc.

4. Unistrut; Part of Atkore International.

- B. Description: MFMA-4, shop- or field-fabricated bracing assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end, with other matching components, and with corrosion-resistant coating; rated in tension, compression, and torsion forces.

2.3 RESTRAINT CABLES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. CADDY; a brand of nVent.
 2. Gripple Inc.
 3. Kinetics Noise Control, Inc.
 4. Vibration Mountings & Controls, Inc.
- B. Restraint Cables: ASTM A603 galvanized-steel cables. End connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; with a minimum of two clamping bolts for cable engagement.

2.4 SEISMIC-RESTRAINT ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
- B. Hanger-Rod Stiffener: Reinforcing steel angle clamped to hanger rod.
- C. Hinged and Swivel Brace Attachments: Multifunctional steel connectors for attaching hangers to rigid channel bracings and restraint cables.
- D. Bushings for Floor-Mounted Equipment Anchor Bolts: Neoprene bushings designed for rigid equipment mountings and matched to type and size of anchor bolts and studs.
- E. Bushing Assemblies for Wall-Mounted Equipment Anchorage: Assemblies of neoprene elements and steel sleeves designed for rigid equipment mountings and matched to type and size of attachment devices used.
- F. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

2.5 MECHANICAL ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
 2. Hilti, Inc.
 3. Kinetics Noise Control, Inc.
 4. Mason Industries, Inc.
- B. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

2.6 ADHESIVE ANCHOR BOLTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Hilti, Inc.
 2. Kinetics Noise Control, Inc.
 3. Mason Industries, Inc.
- B. Adhesive Anchor Bolts: Drilled-in and capsule anchor system containing PVC or urethane methacrylate-based resin and accelerator, or injected polymer or hybrid mortar adhesive. Provide anchor bolts and hardware with zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E488.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for reinforcement and cast-in-place anchors to verify actual locations before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

- A. Multiple Raceways or Cables: Secure raceways and cables to trapezoidal member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

- B. Hanger-Rod Stiffeners: Install hanger-rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods caused by seismic forces.
- C. Strength of Support and Seismic-Restraint Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.3 SEISMIC-RESTRAINT DEVICE INSTALLATION

- A. Coordinate the location of embedded connection hardware with supported equipment attachment and mounting points and with requirements for concrete reinforcement and formwork specified in Section 033000 "Cast-in-Place Concrete."
- B. Equipment and Hanger Restraints:
 - 1. Install resilient, bolt-isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inch.
 - 2. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.
- C. Install cables so they do not bend across edges of adjacent equipment or building structure.
- D. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.
- E. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.
- F. Drilled-in Anchors:
 - 1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.
 - 2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.
 - 3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.
 - 4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.
 - 5. Set anchors to manufacturer's recommended torque using a torque wrench.
 - 6. Install zinc-coated steel anchors for interior and stainless-steel anchors for exterior applications.

3.4 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

- A. Install flexible connections in runs of raceways, cables, wireways, cable trays, and busways where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where connection is terminated to equipment that is anchored to a different structural element from the one supporting them as they approach equipment.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
 - 2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
 - 3. Obtain Architect's approval before transmitting test loads to structure. Provide temporary load-spreading members.
 - 4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.
 - 5. Test to 90 percent of rated proof load of device.
- C. Seismic controls will be considered defective if they do not pass tests and inspections.
- D. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION 260548.16

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

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. Color and legend requirements for raceways, conductors, and warning labels and signs.
 - 2. Labels.
 - 3. Bands and tubes.
 - 4. Tapes and stencils.
 - 5. Tags.
 - 6. Signs.
 - 7. Cable ties.
 - 8. Paint for identification.
 - 9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for electrical identification products.
- B. Identification Schedule: For each piece of electrical equipment and electrical system components to be an index of nomenclature for electrical equipment and system components used in identification signs and labels. Use same designations indicated on Drawings.
- C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Comply with ASME A13.1 and IEEE C2.
- B. Comply with the CEC.

- C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.
- D. Comply with ANSI 535.4 for safety signs and labels.
- E. Comply with NFPA 70E and Section 260573.19 "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.
- F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.
- G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - 1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

- A. Raceways and Cables Carrying Circuits at 600 V or Less:
 - 1. Black letters on an orange field.
 - 2. Legend: Indicate voltage and system or service type.
- B. Color-Coding for Phase- and Voltage-Level Identification, 600 V or Less: Use colors listed below for ungrounded service feeder and branch-circuit conductors.
 - 1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
 - 2. Colors for 208/120-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - c. Phase C: Blue.
 - 3. Colors for 240-V Circuits:
 - a. Phase A: Black.
 - b. Phase B: Red.
 - 4. Colors for 480/277-V Circuits:
 - a. Phase A: Brown.
 - b. Phase B: Orange.
 - c. Phase C: Yellow.
 - 5. Color for Neutral: White.
 - 6. Color for Equipment Grounds: Green.
 - 7. Colors for Isolated Grounds: Green with two or more yellow stripes.
- C. Raceways and Cables Carrying Circuits at More Than 600 V:

1. Black letters on an orange field.
2. Legend: "DANGER - CONCEALED HIGH VOLTAGE WIRING."

D. Warning Label Colors:

1. Identify system voltage with black letters on an orange background.

E. Warning labels and signs shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

F. Equipment Identification Labels:

1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. emedco.
 - d. Grafoplast Wire Markers.
 - e. HellermannTyton.
 - f. LEM Products Inc.
 - g. Marking Services, Inc.
 - h. Panduit Corp.
 - i. Seton Identification Products.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameters and that stay in place by gripping action.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. HellermannTyton.
 - c. Marking Services, Inc.
 - d. Panduit Corp.
 - e. Seton Identification Products.

- C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil-thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. emedco.
 - e. Grafoplast Wire Markers.
 - f. Ideal Industries, Inc.
 - g. LEM Products Inc.
 - h. Marking Services, Inc.
 - i. Panduit Corp.
 - j. Seton Identification Products.
 2. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
 3. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.
- D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3-mil-thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. A'n D Cable Products.
 - b. Brady Corporation.
 - c. Brother International Corporation.
 - d. emedco.
 - e. Grafoplast Wire Markers.
 - f. HellermannTyton.
 - g. Ideal Industries, Inc.
 - h. LEM Products Inc.
 - i. Marking Services, Inc.
 - j. Panduit Corp.
 - k. Seton Identification Products.
 2. Minimum Nominal Size:
 - a. 1-1/2 by 6 inches for raceway and conductors.
 - b. 3-1/2 by 5 inches for equipment.
 - c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

- A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameters and that stay in place by gripping action.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. HellermannTyton.
 - c. Marking Services, Inc.
 - d. Panduit Corp.
- B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameter and shrunk to fit firmly. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Panduit Corp.

2.5 TAPES AND STENCILS

- A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Champion America.
 - c. HellermannTyton.
 - d. Ideal Industries, Inc.
 - e. Marking Services, Inc.
 - f. Panduit Corp.
- B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.

- C. Tape and Stencil: 4-inch-wide black stripes on 10-inch centers placed diagonally over orange background and are 12 inches wide. Stop stripes at legends.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. HellermannTyton.
 - b. LEM Products Inc.
 - c. Marking Services, Inc.
 - d. Seton Identification Products.
- D. Floor Marking Tape: 2-inch-wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Seton Identification Products.
- E. Underground-Line Warning Tape:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Ideal Industries, Inc.
 - c. LEM Products Inc.
 - d. Marking Services, Inc.
 - e. Reef Industries, Inc.
 - f. Seton Identification Products.
 2. Tape:
 - a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
 - b. Printing on tape shall be permanent and shall not be damaged by burial operations.
 - c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.
 3. Color and Printing:
 - a. Comply with ANSI 535.1, ANSI 535.2, ANSI 535.3, ANSI 535.4, and ANSI 535.5.
 - b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE".
 - c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

- F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 TAGS

- A. Metal Tags: Brass or aluminum, 2 by 2 by 0.05 inch, with stamped legend, punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.
 - e. Seton Identification Products.
- B. Nonmetallic Preprinted Tags: Polyethylene tags, 0.015 inch thick, color-coded for phase and voltage level, with factory printed permanent designations; punched for use with self-locking cable tie fastener.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Grafoplast Wire Markers.
 - e. LEM Products Inc.
 - f. Marking Services, Inc.
 - g. Panduit Corp.
 - h. Seton Identification Products.
- C. Write-on Tags:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. LEM Products Inc.
 - c. Seton Identification Products.
 2. Polyester Tags: 0.015 inch thick, with corrosion-resistant grommet and cable tie for attachment.
 3. Marker for Tags: Machine-printed, permanent, waterproof, black ink marker recommended by printer manufacturer.

2.7 SIGNS

A. Baked-Enamel Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Carlton Industries, LP.
 - b. Champion America.
 - c. emedco.
 - d. Marking Services, Inc.
2. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 7 by 10 inches.

B. Metal-Backed Butyrate Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Champion America.
 - c. emedco.
 - d. Marking Services, Inc.
2. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
3. 1/4-inch grommets in corners for mounting.
4. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Brady Corporation.
 - b. Carlton Industries, LP.
 - c. emedco.
 - d. Marking Services, Inc.
2. Engraved legend.
3. Thickness:
 - a. For signs up to 20 sq. in., minimum 1/16 inch thick.
 - b. For signs larger than 20 sq. in., 1/8 inch thick.
 - c. Engraved legend with black letters on white face.

- d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
- e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.8 CABLE TIES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. HellermannTyton.
 - 2. Ideal Industries, Inc.
 - 3. Marking Services, Inc.
 - 4. Panduit Corp.
- B. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black, except where used for color-coding.
- C. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 12,000 psi.
 - 3. Temperature Range: Minus 40 to plus 185 deg F.
 - 4. Color: Black.
- D. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
 - 1. Minimum Width: 3/16 inch.
 - 2. Tensile Strength at 73 Deg F according to ASTM D638: 7000 psi.
 - 3. UL 94 Flame Rating: 94V-0.
 - 4. Temperature Range: Minus 50 to plus 284 deg F.
 - 5. Color: Black.

2.9 MISCELLANEOUS IDENTIFICATION PRODUCTS

- A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).
- B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

3.2 INSTALLATION

- A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.
- B. Install identifying devices before installing acoustical ceilings and similar concealment.
- C. Verify identity of each item before installing identification products.
- D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.
- E. Apply identification devices to surfaces that require finish after completing finish work.
- F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.
- G. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
 - 1. Secure tight to surface of conductor, cable, or raceway.
- H. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.
- I. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.
- J. Vinyl Wraparound Labels:
 - 1. Secure tight to surface of raceway or cable at a location with high visibility and accessibility.
 - 2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.
- K. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

- L. Self-Adhesive Wraparound Labels: Secure tight to surface at a location with high visibility and accessibility.
- M. Self-Adhesive Labels:
 - 1. On each item, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
 - 2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where two lines of text are required, use labels 2 inches high.
- N. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.
- O. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.
- P. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.
- Q. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.
 - 1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.
- R. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.
- S. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.
- T. Underground Line Warning Tape:
 - 1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.
 - 2. Limit use of underground-line warning tape to direct-buried cables.
 - 3. Install underground-line warning tape for direct-buried cables and cables in raceways.
- U. Metal Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using UV-stabilized cable ties.
- V. Nonmetallic Preprinted Tags:
 - 1. Place in a location with high visibility and accessibility.
 - 2. Secure using plenum-rated cable ties.

W. Write-on Tags:

1. Place in a location with high visibility and accessibility.
2. Secure using plenum-rated cable ties.

X. Baked-Enamel Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on minimum 1-1/2-inch-high sign; where two lines of text are required, use signs minimum 2 inches high.

Y. Metal-Backed Butyrate Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

. Laminated Acrylic or Melamine Plastic Signs:

1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
2. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high sign; where two lines of text are required, use labels 2 inches high.

AA. Cable Ties: General purpose, for attaching tags, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. In Spaces Handling Environmental Air: Plenum rated.

3.3 IDENTIFICATION SCHEDULE

- A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.
- B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.
- C. Concealed Raceways, Duct Banks, More Than 600 V, within Buildings: Tape and stencil. Stencil legend "DANGER - CONCEALED HIGH-VOLTAGE WIRING" with 3-inch-high, black letters on 20-inch centers.
 1. Locate identification at changes in direction, at penetrations of walls and floors, and at 10-foot maximum intervals.

- D. Accessible Raceways, Armored and Metal-Clad Cables, More Than 600 V: Vinyl wraparound labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- E. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- F. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use vinyl wraparound labels to identify the phase.
 - 1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.
- G. Power-Circuit Conductor Identification, More Than 600 V: For conductors in vaults, pull and junction boxes, manholes, and handholes, use nonmetallic preprinted tags colored and marked to indicate phase, and a separate tag with the circuit designation.
- H. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive labels with the conductor or cable designation, origin, and destination.
- I. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.
- J. Conductors to Be Extended in the Future: Attach marker tape to conductors and list source.
- K. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.
 - 1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
- L. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.
- M. Concealed Raceways and Duct Banks, More Than 600 V, within Buildings: Apply floor marking tape to the following finished surfaces:
 - 1. Floor surface directly above conduits running beneath and within 12 inches of a floor that is in contact with earth or is framed above unexcavated space.
 - 2. Wall surfaces directly external to raceways concealed within wall.

3. Accessible surfaces of concrete envelope around raceways in vertical shafts, exposed in the building, or concealed above suspended ceilings.
- N. Workspace Indication: Apply floor marking tape or tape and stencil to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with the CEC and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.
- O. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.
- P. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.
1. Apply to exterior of door, cover, or other access.
- Q. Arc Flash Warning Labeling: Self-adhesive labels.
- R. Operating Instruction Signs: Baked-enamel warning signs.
- S. Equipment Identification Labels:
1. Indoor Equipment: Baked-enamel signs .
 2. Outdoor Equipment: Laminated acrylic or melamine sign.
 3. Equipment to Be Labeled:
 - a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be in the form of a engraved, laminated acrylic or melamine label.
 - b. Enclosures and electrical cabinets.
 - c. Access doors and panels for concealed electrical items.
 - d. Switchgear.
 - e. Switchboards.
 - f. Transformers: Label that includes tag designation indicated on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
 - g. Substations.
 - h. Enclosed switches.
 - i. Enclosed circuit breakers.
 - j. Push-button stations.
 - k. Contactors.
 - l. Remote-controlled switches, dimmer modules, and control devices.
 - m. Battery-inverter units.
 - n. Monitoring and control equipment.

END OF SECTION 260553

SECTION 260573.13 - SHORT-CIRCUIT STUDIES

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 a computer-based, fault-current study to determine the minimum interrupting capacity of circuit protective devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Short-circuit study input data, including completed computer program input data sheets.
 - b. Short-circuit study and equipment evaluation report; signed, dated, and sealed by a qualified professional engineer.
 - 1) Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.
 - 2) Revised one-line diagram, reflecting field investigation results and results of short-circuit study.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.
2. For Power System Analysis Specialist.
3. For Field Adjusting Agency.

B. Product Certificates: For short-circuit study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. For overcurrent protective devices to include in emergency, operation, and maintenance manuals.
2. The following are from the Short-Circuit Study Report:
 - a. Final one-line diagram.
 - b. Final Short-Circuit Study Report.
 - c. Short-circuit study data files.
 - d. Power system data.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
 - 1. Power System Analysis Software Qualifications: Computer program shall be designed to perform short-circuit studies or have a function, component, or add-on module designed to perform short-circuit studies.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- D. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- E. Short-Circuit Study Certification: Short-Circuit Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- F. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
- 2. CGI CYME.
- 3. EDSA Micro Corporation.
- 4. ESA Inc.
- 5. Operation Technology, Inc.
- 6. Power Analytics, Corporation.

7. SKM Systems Analysis, Inc.
- B. Comply with IEEE 399 and IEEE 551.
 1. Analytical features of power systems analysis software program shall have capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.
- C. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output.

2.2 SHORT-CIRCUIT STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
 1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations and ratings.
 6. Derating factors and environmental conditions.
 7. Any revisions to electrical equipment required by the study.
- D. Comments and recommendations for system improvements or revisions in a written document, separate from one-line diagram.
- E. Protective Device Evaluation:
 1. Evaluate equipment and protective devices and compare to available short-circuit currents. Verify that equipment withstand ratings exceed available short-circuit current at equipment installation locations.
 2. Tabulations of circuit breaker, fuse, and other protective device ratings versus calculated short-circuit duties.
 3. For 600-V overcurrent protective devices, ensure that interrupting ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
 4. For devices and equipment rated for asymmetrical fault current, apply multiplication factors listed in standards to 1/2-cycle symmetrical fault current.
 5. Verify adequacy of phase conductors at maximum three-phase bolted fault currents; verify adequacy of equipment grounding conductors and grounding electrode conductors at maximum ground-fault currents. Ensure that short-circuit withstand ratings are equal to or higher than calculated 1/2-cycle symmetrical fault current.
- F. Short-Circuit Study Input Data:
 1. One-line diagram of system being studied.

2. Power sources available.
3. Manufacturer, model, and interrupting rating of protective devices.
4. Conductors.
5. Transformer data.

G. Short-Circuit Study Output Reports:

1. Low-Voltage Fault Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Equivalent impedance.
2. Momentary Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. Calculated asymmetrical fault currents:
 - 1) Based on fault-point X/R ratio.
 - 2) Based on calculated symmetrical value multiplied by 1.6.
 - 3) Based on calculated symmetrical value multiplied by 2.7.
3. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each overcurrent device location:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

PART 3 - EXECUTION

3.1 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the study.
 1. Verify completeness of data supplied on one-line diagram. Call any discrepancies to Architect's attention.

2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate the required input data to support the short-circuit study. Comply with requirements in Section 017839 "Project Record Documents" for recording circuit protective device characteristics. Record data on a Record Document copy of one-line diagram. Comply with recommendations in IEEE 551 as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
1. Product Data for Project's overcurrent protective devices involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance at the service.
 3. Power sources and ties.
 4. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 5. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 6. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip, SCCR, current rating, and breaker settings.
 7. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 8. Busway manufacturer and model designation, current rating, impedance, lengths, and conductor material.
 9. Motor horsepower and NEMA MG 1 code letter designation.
 10. Conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 11. Derating factors.

3.2 SHORT-CIRCUIT STUDY

- A. Perform study following the general study procedures contained in IEEE 399.
- B. Calculate short-circuit currents according to IEEE 551.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.

- E. Begin short-circuit current analysis at the service, extending down to system overcurrent protective devices as follows:
 - 1. To normal system low-voltage load buses where fault current is 10 kA or less.
 - 2. Exclude equipment rated 240 V ac or less when supplied by a single transformer rated less than 125 kVA.
- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for the fault-current dc decrement to address asymmetrical requirements of interrupting equipment.
- H. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- I. Include in the report identification of any protective device applied outside its capacity.

END OF SECTION 260573.13

SECTION 260573.16 - COORDINATION STUDIES

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 computer-based, overcurrent protective device coordination studies to determine overcurrent protective devices and to determine overcurrent protective device settings for selective tripping.
 - 1. Study results shall be used to determine coordination of series-rated devices.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled. Existing to remain items shall remain functional throughout the construction period.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power System Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion of the circuit from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data:

1. For computer software program to be used for studies.
2. Submit the following after the approval of system protective devices submittals. Submittals shall be in digital form.
 - a. Coordination-study input data, including completed computer program input data sheets.
 - b. Study and equipment evaluation reports.
3. Overcurrent protective device coordination study report; signed, dated, and sealed by a qualified professional engineer.
 - a. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power System Analysis Software Developer.
2. For Power Systems Analysis Specialist.
3. For Field Adjusting Agency.

- B. Product Certificates: For overcurrent protective device coordination study software, certifying compliance with IEEE 399.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For overcurrent protective devices to include in emergency, operation, and maintenance manuals.

1. The following are from the Coordination Study Report:
 - a. Final one-line diagram.
 - b. Final protective device coordination study.
 - c. Coordination study data files.
 - d. List of all protective device settings.
 - e. Time-current coordination curves.
 - f. Power system data.

1.7 QUALITY ASSURANCE

- A. Studies shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.
- D. Power System Analysis Software Qualifications:
 - 1. Computer program shall be designed to perform coordination studies or have a function, component, or add-on module designed to perform coordination studies.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 POWER SYSTEM ANALYSIS SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. Power Analytics, Corporation.
 - 6. SKM Systems Analysis, Inc.
- B. Comply with IEEE 242 and IEEE 399.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

- D. Computer software program shall be capable of plotting and diagramming time-current-characteristic curves as part of its output. Computer software program shall report device settings and ratings of all overcurrent protective devices and shall demonstrate selective coordination by computer-generated, time-current coordination plots.

1. Optional Features:

- a. Arcing faults.
- b. Simultaneous faults.
- c. Explicit negative sequence.
- d. Mutual coupling in zero sequence.

2.2 COORDINATION STUDY REPORT CONTENTS

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram of modeled power system, showing the following:
1. Protective device designations and ampere ratings.
 2. Conductor types, sizes, and lengths.
 3. Transformer kilovolt ampere (kVA) and voltage ratings.
 4. Motor and generator designations and kVA ratings.
 5. Switchgear, switchboard, motor-control center, and panelboard designations.
 6. Any revisions to electrical equipment required by the study.
 7. Study Input Data: As described in "Power System Data" Article.
 - a. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- D. Protective Device Coordination Study:
1. Report recommended settings of protective devices, ready to be applied in the field. Use manufacturer's data sheets for recording the recommended setting of overcurrent protective devices when available.
 - a. Phase and Ground Relays:
 - 1) Device tag.
 - 2) Relay current transformer ratio and tap, time dial, and instantaneous pickup value.
 - 3) Recommendations on improved relaying systems, if applicable.
 - b. Circuit Breakers:
 - 1) Adjustable pickups and time delays (long time, short time, and ground).

- 2) Adjustable time-current characteristic.
 - 3) Adjustable instantaneous pickup.
 - 4) Recommendations on improved trip systems, if applicable.
- c. Fuses: Show current rating, voltage, and class.
- E. Time-Current Coordination Curves: Determine settings of overcurrent protective devices to achieve selective coordination. Graphically illustrate that adequate time separation exists between devices installed in series, including power utility company's upstream devices. Prepare separate sets of curves for the switching schemes and for emergency periods where the power source is local generation. Show the following information:
1. Device tag and title, one-line diagram with legend identifying the portion of the system covered.
 2. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
 3. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
 4. Plot the following listed characteristic curves, as applicable:
 - a. Power utility's overcurrent protective device.
 - b. Medium-voltage equipment overcurrent relays.
 - c. Medium- and low-voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 - d. Low-voltage equipment circuit-breaker trip devices, including manufacturer's tolerance bands.
 - e. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 - f. Cables and conductors damage curves.
 - g. Ground-fault protective devices.
 - h. Motor-starting characteristics and motor damage points.
 - i. Generator short-circuit decrement curve and generator damage point.
 - j. The largest feeder circuit breaker in each motor-control center and panelboard.
 5. Maintain selectivity for tripping currents caused by overloads.
 6. Maintain maximum achievable selectivity for tripping currents caused by overloads on series-rated devices.
 7. Provide adequate time margins between device characteristics such that selective operation is achieved.
 8. Comments and recommendations for system improvements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals for compliance with electrical distribution system coordination requirements and other conditions affecting performance of the Work. Devices to be coordinated are indicated on Drawings.

1. Proceed with coordination study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to coordination study may not be used in study.

3.2 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the overcurrent protective device study.
 1. Verify completeness of data supplied in one-line diagram on Drawings. Call any discrepancies to Architect's attention.
 2. For equipment included as Work of this Project, use characteristics submitted under provisions of action submittals and information submittals for this Project.
 3. For relocated equipment and that which is existing to remain, obtain required electrical distribution system data by field investigation and surveys, conducted by qualified technicians and engineers. Qualifications of technicians and engineers shall be as defined by NFPA 70E.
- B. Gather and tabulate all required input data to support the coordination study. List below is a guide. Comply with recommendations in IEEE 551 for the amount of detail required to be acquired in the field. Field data gathering shall be under direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
 1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Electrical power utility impedance at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus (three phase and line to ground).
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 8. For reactors, provide manufacturer and model designation, voltage rating, and impedance.
 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Maximum demands from service meters.
 13. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
 14. Motor horsepower and NEMA MG 1 code letter designation.

15. Low-voltage cable sizes, lengths, number, conductor material, and conduit material (magnetic or nonmagnetic).
16. Medium-voltage cable sizes, lengths, conductor material, cable construction, metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
17. Data sheets to supplement electrical distribution system one-line diagram, cross-referenced with tag numbers on diagram, showing the following:
 - a. Special load considerations, including starting inrush currents and frequent starting and stopping.
 - b. Transformer characteristics, including primary protective device, magnetic inrush current, and overload capability.
 - c. Motor full-load current, locked rotor current, service factor, starting time, type of start, and thermal-damage curve.
 - d. Generator thermal-damage curve.
 - e. Ratings, types, and settings of utility company's overcurrent protective devices.
 - f. Special overcurrent protective device settings or types stipulated by utility company.
 - g. Time-current-characteristic curves of devices indicated to be coordinated.
 - h. Manufacturer, frame size, interrupting rating in amperes root mean square (rms) symmetrical, ampere or current sensor rating, long-time adjustment range, short-time adjustment range, and instantaneous adjustment range for circuit breakers.
 - i. Manufacturer and type, ampere-tap adjustment range, time-delay adjustment range, instantaneous attachment adjustment range, and current transformer ratio for overcurrent relays.
 - j. Switchgear, switchboards, motor-control centers, and panelboards ampacity, and SCCR in amperes rms symmetrical.
 - k. Identify series-rated interrupting devices for a condition where the available fault current is greater than the interrupting rating of downstream equipment. Obtain device data details to allow verification that series application of these devices complies with the CEC and UL 489 requirements.

3.3 COORDINATION STUDY

- A. Comply with IEEE 242 for calculating short-circuit currents and determining coordination time intervals.
- B. Comply with IEEE 399 for general study procedures.
- C. Base study on device characteristics supplied by device manufacturer.
- D. Extent of electrical power system to be studied is indicated on Drawings.
- E. Begin analysis at the service, extending down to system overcurrent protective devices as follows:
 1. To normal system low-voltage load buses where fault current is 10 kA or less.

- F. Study electrical distribution system from normal and alternate power sources throughout electrical distribution system for Project. Study all cases of system-switching configurations and alternate operations that could result in maximum fault conditions.
- G. Transformer Primary Overcurrent Protective Devices:
 - 1. Device shall not operate in response to the following:
 - a. Inrush current when first energized.
 - b. Self-cooled, full-load current or forced-air-cooled, full-load current, whichever is specified for that transformer.
 - c. Permissible transformer overloads according to IEEE C57.96 if required by unusual loading or emergency conditions.
 - 2. Device settings shall protect transformers according to IEEE C57.12.00, for fault currents.
- H. Motor Protection:
 - 1. Select protection for low-voltage motors according to IEEE 242 and the CEC.
 - 2. Select protection for motors served at voltages more than 600 V according to IEEE 620.
- I. Conductor Protection: Protect cables against damage from fault currents according to ICEA P-32-382, ICEA P-45-482, and protection recommendations in IEEE 242. Demonstrate that equipment withstands the maximum short-circuit current for a time equivalent to the tripping time of the primary relay protection or total clearing time of the fuse. To determine temperatures that damage insulation, use curves from cable manufacturers or from listed standards indicating conductor size and short-circuit current.
- J. Generator Protection: Select protection according to manufacturer's written instructions and to IEEE 242.
- K. Include the ac fault-current decay from induction motors, synchronous motors, and asynchronous generators and apply to low- and medium-voltage, three-phase ac systems. Also account for fault-current dc decrement, to address asymmetrical requirements of interrupting equipment.
- L. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault and a single line-to-ground fault at each equipment indicated on one-line diagram.
 - 1. For grounded systems, provide a bolted line-to-ground fault-current study for areas as defined for the three-phase bolted fault short-circuit study.
- M. Protective Device Evaluation:
 - 1. Evaluate equipment and protective devices and compare to short-circuit ratings.
 - 2. Adequacy of switchgear, motor-control centers, and panelboard bus bars to withstand short-circuit stresses.
 - 3. Any application of series-rated devices shall be recertified, complying with requirements in the CEC.

4. Include in the report identification of any protective device applied outside its capacity.

3.4 LOAD-FLOW AND VOLTAGE-DROP STUDY

- A. Perform a load-flow and voltage-drop study to determine the steady-state loading profile of the system. Analyze power system performance two times as follows:
 1. Determine load flow and voltage drop based on full-load currents obtained in "Power System Data" Article.
 2. Determine load flow and voltage drop based on 80 percent of the design capacity of load buses.
 3. Prepare load-flow and voltage-drop analysis and report to show power system components that are overloaded, or might become overloaded; show bus voltages that are less than as prescribed by the CEC.

3.5 MOTOR-STARTING STUDY

- A. Perform a motor-starting study to analyze the transient effect of system's voltage profile during motor starting. Calculate significant motor-starting voltage profiles and analyze the effects of motor starting on the power system stability.
- B. Prepare the motor-starting study report, noting light flicker for limits proposed by IEEE 141, and, and voltage sags so as not to affect operation of other utilization equipment on system supplying the motor.

3.6 FIELD ADJUSTING

- A. Adjust relay and protective device settings according to recommended settings provided by the coordination study. Field adjustments shall be completed by the engineering service division of equipment manufacturer under the "Startup and Acceptance Testing" contract portion.
- B. Make minor modifications to equipment as required to accomplish compliance with short-circuit and protective device coordination studies.
- C. Testing and adjusting shall be by a full-time employee of the Field Adjusting Agency, who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification.
 1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters. Perform NETA tests and inspections for all adjustable overcurrent protective devices.

3.7 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in the following:

1. Acquaint personnel in fundamentals of operating the power system in normal and emergency modes.
2. Hand-out and explain the coordination study objectives, study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpreting time-current coordination curves.
3. For Owner's maintenance staff certified as NETA ETT-Certified Technicians Level III or NICET Electrical Power Testing Level III Technicians, teach how to adjust, operate, and maintain overcurrent protective device settings.

END OF SECTION 260573.16

SECTION 260573.19 - ARC-FLASH HAZARD ANALYSIS

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 a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

- A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
- B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.
- C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.
- D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.
- E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.
- F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.
- G. SCCR: Short-circuit current rating.
- H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.
- I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

- A. Product Data: For computer software program to be used for studies.
- B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:
 - 1. Arc-flash study input data, including completed computer program input data sheets.
 - 2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
 - 3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data:
 - 1. For Power Systems Analysis Software Developer.
 - 2. For Power System Analysis Specialist.
 - 3. For Field Adjusting Agency.
- B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data:
 - 1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.
 - 2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

- A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.
- B. Software algorithms shall comply with requirements of standards and guides specified in this Section.
- C. Manual calculations are unacceptable.

- D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.
 - 1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.
 - 2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.
- E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.
- F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.
- G. Field Adjusting Agency Qualifications:
 - 1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.
 - 2. A member company of NETA.
 - 3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. CGI CYME.
 - 2. EDSA Micro Corporation.
 - 3. ESA Inc.
 - 4. Operation Technology, Inc.
 - 5. Power Analytics, Corporation.
 - 6. SKM Systems Analysis, Inc.
- B. Comply with IEEE 1584 and NFPA 70E.
- C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

- A. Executive summary of study findings.
- B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.
- C. One-line diagram, showing the following:
 - 1. Protective device designations and ampere ratings.
 - 2. Conductor types, sizes, and lengths.
 - 3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
 - 4. Motor and generator designations and kVA ratings.
 - 5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
- D. Study Input Data: As described in "Power System Data" Article.
- E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
- F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- G. Arc-Flash Study Output Reports:
 - 1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
 - a. Voltage.
 - b. Calculated symmetrical fault-current magnitude and angle.
 - c. Fault-point X/R ratio.
 - d. No AC Decrement (NACD) ratio.
 - e. Equivalent impedance.
 - f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.
 - g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.
- H. Incident Energy and Flash Protection Boundary Calculations:
 - 1. Arcing fault magnitude.
 - 2. Protective device clearing time.
 - 3. Duration of arc.
 - 4. Arc-flash boundary.
 - 5. Restricted approach boundary.
 - 6. Limited approach boundary.
 - 7. Working distance.
 - 8. Incident energy.
 - 9. Hazard risk category.

10. Recommendations for arc-flash energy reduction.

- I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.
- B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
 1. Location designation.
 2. Nominal voltage.
 3. Protection boundaries.
 - a. Arc-flash boundary.
 - b. Restricted approach boundary.
 - c. Limited approach boundary.
 4. Arc flash PPE category.
 5. Required minimum arc rating of PPE in Cal/cm squared.
 6. Available incident energy.
 7. Working distance.
 8. Engineering report number, revision number, and issue date.
- C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

- A. Comply with NFPA 70E and its Annex D for hazard analysis study.
- B. Preparatory Studies: Perform the Short-Circuit and Protective Device Coordination study studies prior to starting the Arc-Flash Hazard Analysis or obtain results from another source.

1. Short-Circuit Study Output: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in Section 260573.13 "Short-Circuit Studies."
 2. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."
- C. Calculate maximum and minimum contributions of fault-current si□e.
1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
 2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
 3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
 4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.
- D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.
- E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.
- F. Calculate the limited, restricted, and prohibited approach boundaries for each location.
- G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:
1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
 2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
- H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:
1. When the circuit breaker is in a separate enclosure.
 2. When the line terminals of the circuit breaker are separate from the work location.
- I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

- A. Obtain all data necessary for conduct of the arc-flash hazard analysis.
1. Verify completeness of data supplied on one-line diagram on Drawings and under "Preparatory Studies" Paragraph in "Arc-Flash Hazard Analysis" Article. Call discrepancies to Architect's attention.
 2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
 3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.
- B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:
1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
 2. Obtain electrical power utility impedance or available short circuit current at the service.
 3. Power sources and ties.
 4. Short-circuit current at each system bus (three phase and line to ground).
 5. Full-load current of all loads.
 6. Voltage level at each bus.
 7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
 8. For reactors, provide manufacturer and model designation, voltage rating and impedance.
 9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
 10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
 11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
 12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
 13. Motor horsepower and NEMA MG 1 code letter designation.
 14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
 15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

- A. Apply one arc-flash label on the front cover of each section of the equipment and on side or rear covers with accessible live parts and hinged doors or removable plates for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.
- B. Each piece of equipment listed below shall have an arc-flash label applied to it:
 - 1. Motor-control center.
 - 2. Low-voltage switchboard.
 - 3. Switchgear.
 - 4. Medium-voltage switch.
 - 5. Medium voltage transformers
 - 6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
 - 7. Panelboard and safety switch over 250 V.
 - 8. Applicable panelboard and safety switch under 250 V.
 - 9. Control panel.
- C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.
 - 1. Indicate arc-flash energy.
 - 2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

- A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

- A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION 260573.19

SECTION 260923 - LIGHTING CONTROL DEVICES

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. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching and dimming controls.
4. Indoor occupancy and vacancy sensors.
5. Switchbox-mounted occupancy sensors.
6. Digital timer light switches.
7. High-bay occupancy sensors.
8. Extreme temperature occupancy sensors.
9. Outdoor motion sensors.
10. Lighting contactors.
11. Emergency shunt relays.

- B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS

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

- B. Shop Drawings:

1. Show installation details for the following:
 - a. Occupancy sensors.
 - b. Vacancy sensors.
2. Interconnection diagrams showing field-installed wiring.
3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and elevations, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Suspended ceiling components.
 - 2. Structural members to which equipment will be attached.
 - 3. Items penetrating finished ceiling, including the following:
 - a. Luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Control modules.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media. Provide names, versions, and website addresses for locations of installed software.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.6 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Faulty operation of lighting control software.
 - b. Faulty operation of lighting control devices.
 - c. .
 - 2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTRONIC TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Invensys Controls.
 4. Leviton Manufacturing Co., Inc.
 5. NSi Industries LLC.
 6. TE Connectivity Ltd.
- B. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
1. Listed and labeled as defined in the CEC and marked for intended location and application.
 2. Contact Configuration: SPST.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.
 4. Programs: Eight on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 6. Astronomic Time: All channels.
 7. Automatic daylight savings time changeover.
 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 ELECTROMECHANICAL DIAL-TIME SWITCHES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Intermatic, Inc.
 3. Invensys Controls.
 4. Leviton Manufacturing Co., Inc.
 5. NSi Industries LLC.
 6. TE Connectivity Ltd.
- B. Electromechanical-Dial Time Switches: Comply with UL 917.
1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 2. Contact Configuration: DPST SPDT.
 3. Contact Rating: 30-A inductive or resistive, 240-V ac.

4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
5. Astronomic time dial.
6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
7. Skip-a-day mode.
8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

- B. Description: Solid state, with DPST dry contacts rated for 1800 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in the CEC, by a agency NRTL, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.4 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, LUMINAIRE-MOUNTED

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

- B. Description: Solid state, with DPST dry contacts rated for 1800 VA inductive, to operate connected load, complying with UL 773, and compatible with CFL and LED lamps.

1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with ANSI C136.10, with base from same source and manufacturer as switch.
6. Failure Mode: Luminaire stays ON.

2.5 OUTDOOR PHOTOELECTRIC SWITCHES, LOW VOLTAGE

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Leviton Manufacturing Co., Inc.
4. NSi Industries LLC.
5. TE Connectivity Ltd.

- B. Description: Solid state; one set of NO dry contacts rated for 24 V ac at 1 A, to operate connected load, complying with UL 773, and compatible with power pack.

1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc, with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Mounting: 1/2-inch threaded male conduit.
5. Failure Mode: Luminaire stays ON.
6. Power Pack: Digital controller capable of accepting four RJ45 inputs with two outputs rated for 20-A incandescent or LED load at 120- and 277-V ac, for 16-A ballast or LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, Class 2 power source, as defined by the CEC.
 - a. With integral current monitoring.
 - b. Compatible with digital addressable lighting interface.
 - c. Plenum rated.

2.6 DAYLIGHT-HARVESTING SWITCHING CONTROLS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Eaton.

3. Hubbell Building Automation, Inc.
 4. Leviton Manufacturing Co., Inc.
 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
 6. NSi Industries LLC.
 7. Sensor Switch, Inc.
 8. TE Connectivity Ltd.
 9. WattStopper; a Legrand Group brand.
- B. Description: System operates indoor lighting.
- C. Sequence of Operation: As daylight increases, the lights are turned off at a predetermined level. As daylight decreases, the lights are turned on at a predetermined level.
1. Lighting control set point is based on two lighting conditions:
 - a. When no daylight is present.
 - b. When significant daylight is present (target level).
 - c. System programming is done with two hand-held, remote-control tools.
- D. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with integrated power pack, that detects changes in indoor lighting levels that are perceived by the eye.
- E. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
 3. Sensor Output: Digital signal compatible with power pack.
 4. Sensor type: Open loop.
 5. one: Multi.
 6. Power Pack: Digital controller capable of accepting 4 RJ45 inputs with two outputs rated for 20-A incandescentor LED load at 120- and 277-V ac, for 16-A ballast or LEDat 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by the CEC.
 - a. With integral current monitoring
 - b. Compatible with digital addressable lighting interface.
 - c. Plenum rated.
 7. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc, with an adjustment for turn-on and turn-off levels within that range.
 8. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc, with an adjustment for turn-on and turn-off levels within that range.
 9. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc, with an adjustment for turn-on and turn-off levels within that range.
 10. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
 11. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
 12. Test Mode: User selectable, overriding programmed time delay to allow settings check.

13. Control Load Status: User selectable to confirm that load wiring is correct.
14. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.7 DAYLIGHT-HARVESTING DIMMING CONTROLS, DIGITAL

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Cooper Industries, Inc.
 2. Deep Roof Lighting.
 3. Hubbell Building Automation, Inc.
 4. Leviton Manufacturing Co., Inc.
 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
 6. WattStopper; a Legrand Group brand.
- B. Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, lights are dimmed.
1. Lighting control set point is based on the following two lighting conditions:
 - a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
- C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with integrated power pack mounted on luminaire, to detect changes in indoor lighting levels that are perceived by the eye.
- D. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate luminaires. Sensor is powered by controller unit.
 3. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc.
- E. Power Pack: Digital controller capable of accepting four RJ45 inputs with two output(s) rated for 20-A incandescent or LED load at 120- and 277-V ac, for 16-A ballast load or LED at 120- and 277-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc Class 2 power source, as defined by the CEC.
1. With integral current monitoring.
 2. Compatible with digital addressable lighting interface.
 3. Plenum rated.

2.8 INDOOR OCCUPANCY AND VACANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bryant Electric.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Intermatic, Inc.
 5. Leviton Manufacturing Co., Inc.
 6. Lithonia Lighting; Acuity Brands Lighting, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC.
 9. Philips Lighting Controls.
 10. RAB Lighting.
 11. Sensor Switch, Inc.
 12. Square D.
 13. WattStopper; a Legrand Group brand.
- B. General Requirements for Sensors:
1. Wall or Ceiling-mounted, solid-state indoor occupancy and vacancy sensors.
 2. Dual technology.
 3. Integrated power pack.
 4. Hardwired connection to switch.
 5. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 6. Operation:
 - a. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 7. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A.
 8. Power: Line voltage.
 9. Power Pack: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by the CEC.
 10. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 12. Bypass Switch: Override the "on" function in case of sensor failure.

13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc; turn lights off when selected lighting level is present.
- C. PIR Type: Wall or Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in..
 2. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 48 inches above finished floor.
- D. Ultrasonic Type: Wall or Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 2. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch-high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot-high ceiling in a corridor not wider than 14 feet.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 1000 square feet when mounted 84 inches above finished floor.
- E. Dual-Technology Type: Wall or Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in., and detect a person of average size and weight moving not less than 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch-high ceiling.
 4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of 2000 square feet when mounted 48 inches above finished floor.

2.9 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bryant Electric.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Intermatic, Inc.

5. Leviton Manufacturing Co., Inc.
6. Lithonia Lighting; Acuity Brands Lighting, Inc.
7. Lutron Electronics Co., Inc.
8. NSi Industries LLC.
9. Philips Lighting Controls.
10. RAB Lighting.
11. Sensor Switch, Inc.
12. Square D.
13. WattStopper; a Legrand Group brand.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 800-VA ballast or LED load at 120 V, 1200-VA ballast or LED load at 277 V, and 800-W incandescent.

2.10 DIGITAL TIMER LIGHT SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. Invensys Controls.
4. Leviton Manufacturing Co., Inc.
5. NSi Industries LLC.
6. TE Connectivity Ltd.

B. Description: Combination digital timer and conventional switch lighting control unit. Switchbox-mounted, backlit LCD display, with selectable time interval in 10 minute increments.

1. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
2. Standards: Comply with UL 20.
3. Voltage: Match the circuit voltage.
4. Color: White.
5. Faceplate: Color matched to switch.

2.11 OUTDOOR MOTION SENSORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Bryant Electric.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Manufacturing Co., Inc.
 5. Lithonia Lighting; Acuity Brands Lighting, Inc.
 6. NSi Industries LLC.
 7. RAB Lighting.
 8. Sensor Switch, Inc.
 9. WattStopper; a Legrand Group brand.
- B. Description: Solid-state outdoor motion sensors.
1. Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application, and shall comply with California Title 24.
 2. Dual-technology (PIR and ultrasonic) type, weatherproof. Detect occurrences of 6-inch-minimum movement of any portion of a human body that presents a target of not less than 36 sq. in.. Comply with UL 773A.
 3. Switch Rating:
 - a. Luminaire-Mounted Sensor: 1000-W incandescent, 500-VA fluorescent/LED.
 - b. Separately Mounted Sensor: Dry contacts rated for 20-A ballast or LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by the CEC.
 4. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off." With bypass switch to override the "on" function in case of sensor failure.
 5. Voltage: Match the circuit voltage type.
 6. Detector Coverage:
 - a. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft..
 - b. Long Range: 180-degree field of view and 110-foot detection range.
 7. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc. The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
 8. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
 9. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and help eliminate false "off" switching.
 10. Operating Ambient Conditions: Suitable for operation in ambient temperatures ranging from minus 40 to plus 130 deg F, rated as "raintight" according to UL 773A.

2.12 LIGHTING CONTACTORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allen-Bradley/Rockwell Automation.
 2. ASCO: a brand of Vertiv.
 3. Eaton.
 4. General Electric Company.
 5. Square D.
- B. Description: Electrically operated and mechanically held, combination-type lighting contactors with fusible switch, complying with NEMA ICS 2 and UL 508.
1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
 2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
 3. Enclosure: Comply with NEMA 250.
 4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.13 EMERGENCY SHUNT RELAY

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lighting Control and Design.
 2. WattStopper; a Legrand Group brand.
- B. Description: NC, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
1. Coil Rating: 277 V.

2.14 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

- C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.
- B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

- A. Comply with NECA 1.
- B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

- A. Comply with NECA 1.
- B. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.4 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch.
- C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

- A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- B. Label time switches and contactors with a unique designation.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Lighting control devices will be considered defective if they do not pass tests and inspections.
- E. Prepare test and inspection reports.

3.7 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting lighting control devices to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.

2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 SOFTWARE SERVICE AGREEMENT

- A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule and access the system and to upgrade computer equipment if necessary.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 260936 - MODULAR DIMMING CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Wall-box, multiscene, modular dimming controls.
 - 2. Multipreset modular dimming controls.

1.3 DEFINITIONS

- A. BAS: Building automation system.
- B. Fade Rate: The time it takes each □one to arrive at the next scene, dependent on the degree of change in lighting level.
- C. Low Voltage: As defined in the CEC, the term for circuits and equipment operating at less than 50 V or for remote-control, signaling, and power-limited circuits.
- D. RFI: Radio-frequency interference.
- E. Scene: The lighting effect created by adjusting several □ones of lighting to the desired intensity.
- F. SCR: Silicon-controlled rectifier.
- G. □one: A luminaire or group of luminaires controlled simultaneously as a single entity. Also known as a "channel."

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. For modular dimming controls; include elevation, dimensions, features, characteristics, ratings, and labels.
 - 2. Device plates and plate color and material.
 - 3. Ballast and lamp combinations compatible with dimmers.
 - 4. Sound data including results of operational tests of central dimming controls.

5. Operational documentation for software and firmware.
- B. Shop Drawings: Detail assemblies of standard components, custom assembled for specific application on Project. Indicate dimensions, weights, arrangement of components, and clearance and access requirements.
1. Include elevation views of front panels of control and indicating devices and control stations.
 2. Include diagrams for power, signal, and control wiring.
 3. Address Drawing: Reflected ceiling plan and floor plans, showing connected luminaires, address for each luminaire, and luminaire groups. Base plans on construction plans, using the same legend, symbols, and schedules.
 4. Point List and Data Bus Load: Summary list of all control devices, sensors, ballasts, and other loads. Include percentage of rated connected load and device addresses.
 5. Wire Termination Diagrams and Schedules: Coordinate nomenclature and presentation with Drawings and block diagram. Differentiate between manufacturer-installed and field-installed wiring.
 6. Block Diagram: Show interconnections between components specified in this Section and devices furnished with power distribution system components. Indicate data communication paths and identify networks, data buses, data gateways, concentrators, and other devices used. Describe characteristics of network and other data communication lines.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Submit evidence that lighting controls are compatible with connected monitoring and control devices and systems specified in
1. Show interconnecting signal and control wiring, and interface devices that show compatibility of inputs and outputs.
 2. For control interfaces and adapters, list network protocols and provide statements from manufacturers that input and output devices comply with interoperability requirements of the protocol.
- B. Field quality-control reports.
- C. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For standalone multipreset modular dimming controls to include in emergency, operation, and maintenance manuals.
1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Software manuals.
 - b. Adjustments of scene preset controls, adjustable fade rates, and fade overrides.

- c. Operation of adjustable ☐one controls.
- d. Testing and adjusting of panic and emergency power features.

1.7 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of standalone multipreset modular dimming controls that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Damage from transient voltage surges.
 - 2. Warranty Period: Cost to repair or replace any parts for two years from date of Substantial Completion.
 - 3. Extended Warranty Period: Cost of replacement parts (materials only, f.o.b. the nearest shipping point to Project site), for eight years, that failed in service due to transient voltage surges.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Douglas Lighting Controls.
 - 2. Leviton Manufacturing Co., Inc.
 - 3. Lightolier; a Philips group brand.
 - 4. Lutron Electronics Co., Inc.
 - 5. Philips Lighting Controls.

2.2 SYSTEM DESCRIPTION

- A. Compatibility:
 - 1. Dimming control components shall be compatible with luminaires, ballasts, and transformers.
 - 2. Dimming control devices shall be compatible with lighting control system components specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls," and in Section 260923 "Lighting Control Devices."
- B. Dimmers and Dimmer Modules: Comply with UL 508.

1. Audible Noise and RFI Suppression: Solid-state dimmers shall operate smoothly over their operating ranges without audible lamp or dimmer noise or RFI. Modules shall include integral or external filters to suppress audible noise and RFI.
 2. Dimmer or Dimmer-Module Rating: Not less than 125 percent of connected load unless otherwise indicated.
- C. Capacities: Unit shall be rated for 2400 W at 240-V ac and 2000 W at 120-V ac for up to 100 devices or ☐ones.
- D. Surge Protection: Withstand supply power surges without impairment to performance.
1. Panels: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.
 2. Other System Devices: 6000 V, 3000 A, complying with IEEE C62.41.1 and IEEE C62.41.2.
- E. Off Control Position: User-selected off position of any control point shall disconnect the load from line supply.
- F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.

2.3 WALL-BOX MULTISCENE DIMMING CONTROLS

- A. Description: Factory-fabricated equipment providing manual dimming consisting of a wall-box-mounted master controller and indicated number of wall-box ☐one stations. Controls and dimmers shall be integrated for mounting in multigang wall box under a single wall plate. Each ☐one shall be adjustable to indicated number of scenes, which shall reside in the memory of ☐one controller.
- B. Dimmers: Each ☐one shall be configurable to control the following loads:
1. Fluorescent lamps with electronic ballasts.
 2. LED lamps.
 3. Incandescent lamps.
 4. Low-voltage lamps, derived with electronic transformers.
 5. Non-dim, on-off switching only.
- C. Dimmers: Regulate voltages to maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of rms voltage.
- D. Memory:
1. Retain preset scenes and fade rates through momentary (up to 3-second) power interruptions.
 2. Retain preset scenes through power failures for at least seven days.
- E. Device Plates: Style, material, and color shall comply with Section 262726 "Wiring Devices." Master-control cover plate shall be one piece.

- F. Master controller shall include the following:
1. Cover-mounted switches, including master off, all bright, and selectors for each scene.
 2. Cover-mounted LED indicator lights, one associated with each scene switch, and one for the master off switch.
 3. Concealed switches and indicators for specified function.
 4. A raise/lower switch for each ☐one for temporary adjustments of the ☐one, without altering scene values stored in memory.
 5. Fade time indicated by digital display for current scene while fading.
 6. Cover-mounted infrared receiver.
- G. Infrared Transmitters: Wireless remote control for recalling four of the presets. Operate up to 50 feet within line of sight of the master controller.

2.4 MULTIPRESET MODULAR DIMMING CONTROLS

- A. Description: Factory-fabricated equipment providing manual dimming consisting of the following:
1. Master controller.
 2. Controls and dimmers shall be integrated for mounting in a multigang wall box under a single wall plate.
 3. Each ☐one shall be adjustable to indicated number of scenes, which shall reside in the memory of ☐one controller.
- B. Dimmers: Each ☐one shall be configurable to control the following loads:
1. Fluorescent lamps with electronic ballasts.
 2. LED lamps.
 3. Incandescent lamps.
 4. Low-voltage incandescent lamps, derived with electronic transformers.
 5. Non-dim, on-off switching only.
 6. Neon and cold-cathode lighting.
- C. Dimmers: Regulate voltages to maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of rms voltage.
- D. Memory: Retain preset scenes and fade settings through power failures by retaining physical settings of controls.
- E. Device Plates: Style, material, and color shall comply with Section 262726 "Wiring Devices." Master-control cover plate shall be one piece.
- F. Master controller shall include the following:
1. Wall-box style, single coverplate supplied by manufacturer.
 2. Cover-mounted switches, including master off, all bright, and selectors for each scene.
 3. Cover-mounted LED indicator lights, one associated with each scene switch, and one for the master off switch.

4. Concealed switches and indicators for specified function.
5. A raise/lower switch for each ☐one for temporary adjustments of the ☐one, without altering scene values stored in memory.
6. Fade time indicated by digital display for current scene while fading.
7. Cover-mounted infrared receiver.

G. Remote-Control Stations:

1. Numbered push buttons to select scenes.
2. Off switch to turn master station off. Operating the off switch at any remote station shall automatically turn on selected housekeeping lighting.
3. On switch turns all scenes of master station to full bright.
4. Control Wiring: the CEC, Class 2.
5. Mounting: Single flush wall box with manufacturer's standard faceplate.

H. Infrared Remote-Control Station: Same functions as for standard remote-control station except that functions are input by a hand-held infrared transmitter. Operate up to 50 feet within line of sight of the master controller.

I. Dimmer Panels: Modular, plug-in type, complying with UL 508.

1. Integrated Short-Circuit Rating:, 14 kA at 277 V.
2. Dimmers:
 - a. Dimming Circuit: Two SCR dimmers, in inverse parallel configuration.
 - b. Dimming Curve: Modified "square law" as specified in IES's "Lighting Handbook"; control voltage is 0- to 10-V dc.
 - c. Dimming Range: zero to 100 percent, full output voltage not less than 98 percent of line voltage.
 - d. Voltage Regulation: Dimmer shall maintain a constant light level, with no visible flicker, when the source voltage varies plus or minus 2 percent of rms voltage.

J. Circuit Breakers: Complying with UL 489 and classified as switch duty.

2.5 CONDUCTORS AND CABLES

- A. Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Class 2 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 WIRING INSTALLATION

- A. Comply with NECA 1.
- B. Wiring Method: Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size shall be 1/2 inch.
- C. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.2 IDENTIFICATION

- A. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Label each dimmer module with a unique designation.
- C. Label each scene control button with approved scene description.

3.3 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Continuity tests of circuits.
 - 2. Operational Test: Set and operate controls to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.
 - a. Include testing of modular dimming control equipment under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

- D. Dimming control components will be considered defective if they do not pass tests and inspections.
- E. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.
- F. Reports: Written reports of tests and observations. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain modular dimming controls. Laptop portable computer shall be used in training.

END OF SECTION 260936

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

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 distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
 - 2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
- B. Shop Drawings:
 - 1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Seismic Qualification Data: Certificates, for transformers, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
4. Certification: Indicate that equipment meets Project seismic requirements.

- C. Source quality-control reports.
- D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.
 1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.
- B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.
- C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.
- D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Acme Electric Corporation.
 2. Controlled Power Company; an Emerson company.

3. Dongan Electric Manufacturing Company.
4. Eaton.
5. Federal Pacific.
6. General Electric Company.
7. Hammond Power Solutions Inc.
8. Jefferson Electric, Inc.
9. Lincoln Electric Products Co., Inc.
10. Mag-Tran; a division of Quality Transformer & Electronics.
11. Marcus Transformer LTD.
12. MGM Transformer Company.
13. Micron Industries Corporation.
14. Mirus International Inc.
15. Powersmiths International Corp.
16. Rex Power Magnetics.
17. Siemens Industry, Inc., Energy Management Division.
18. Sola/Hevi-Duty; a brand of Emerson Electric Co.
19. Square D; by Schneider Electric.
20. TEMCo Transformers.

- B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Transformers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. The term "withstand" means "the transformer will remain in place without separation of any parts when subjected to the seismic forces specified and the transformer will be fully operational after the seismic event."

2.3 GENERAL TRANSFORMER REQUIREMENTS

- A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.
- B. Comply with the CEC.
1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.
- C. Transformers Rated 15 kVA and Larger:
1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
 2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.
- D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.

2.4 DISTRIBUTION TRANSFORMERS

- A. Comply with the CEC, and list and label as complying with UL 1561.
- B. Provide transformers that are constructed to withstand seismic forces specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- C. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
 - 1. One leg per phase.
 - 2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
 - 3. Grounded to enclosure.
- D. Coils: Continuous windings without splices except for taps.
 - 1. Coil Material: Copper.
 - 2. Internal Coil Connections: Braided or pressure type.
 - 3. Terminal Connections: Bolted.
- E. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.
- F. Enclosure: Ventilated.
 - 1. NEMA 250, Type 2: Core and coil shall be encapsulated within resin compound using a vacuum-pressure impregnation process to seal out moisture and air.
 - 2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
 - 3. Wiring Compartment: Sized for conduit entry and wiring installation.
 - 4. Finish: Comply with NEMA 250.
 - a. Finish Color: ANSI 61 gray weather-resistant enamel.
- G. Taps for Transformers 3 kVA and Smaller: One 5 percent tap above normal full capacity.
- H. Taps for Transformers 7.5 to 24 kVA: One 5 percent tap above and one 5 percent tap below normal full capacity.
- I. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and four 2.5 percent taps below normal full capacity.
- J. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- K. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.
- L. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

- M. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
1. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor, without exceeding the indicated insulation class in a 40 deg C maximum ambient and a 24-hour average ambient of 30 deg C.
 2. Indicate value of K-factor on transformer nameplate.
 3. Unit shall comply with requirements of DOE 2016 efficiency levels when tested according to NEMA TP 2 with a K-factor equal to one.
- N. Electrostatic Shielding: Each winding shall have an independent, single, full-width copper electrostatic shield arranged to minimize interwinding capacitance.
1. Arrange coil leads and terminal strips to minimize capacitive coupling between input and output terminals.
 2. Include special terminal for grounding the shield.
- O. Neutral: Rated 200 percent of full load current for K-factor-rated transformers.
- P. Wall Brackets: Manufacturer's standard brackets.
- Q. Low-Sound-Level Requirements: Maximum sound levels when factory tested according to IEEE C57.12.91, as follows:
1. 9.00 kVA and Less: 40 dBA.
 2. 9.01 to 30.00 kVA: 45 dBA.
 3. 30.01 to 50.00 kVA: 48 dBA for K-factors of 13 and 20.
 4. 50.01 to 150.00 kVA: 53 dBA for K-factors of 13 and 20.
 5. 150.01 to 300.00 kVA: 58 dBA for K-factors of 13 and 20.
 6. 300.01 to 500.00 kVA: 63 dBA for K-factors of 13 and 20.
 7. 500.01 to 700.00: 65 dBA for K-factors of 13 and 20.
 8. 700.01 to 1000.00: 67 dBA for K-factors of 13 and 20.
- R. All exterior transformers shall be anti-corrosive and suitable for marine environment.

2.5 IDENTIFICATION

- A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260553 "Identification for Electrical Systems."

2.6 SOURCE QUALITY CONTROL

- A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.
1. Resistance measurements of all windings at rated voltage connections and at all tap connections.

2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
 - a. High-voltage to ground.
 - b. Low-voltage to ground.
 - c. High-voltage to low-voltage.
9. Temperature tests.

- B. Factory Sound-Level Tests: Conduct prototype sound-level tests on production-line products.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.
- B. Verify that field measurements are as needed to maintain working clearances required by the CEC and manufacturer's written instructions.
- C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.
- D. Verify that ground connections are in place and requirements in Section 260526 "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.
- E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.
- F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
 1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

- B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.
- C. Construct concrete bases according to Section 033000 "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions, seismic codes applicable to Project, and requirements in Section 260529 "Hangers and Supports for Electrical Systems."
 - 1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.
- D. Secure transformer to concrete base according to manufacturer's written instructions.
- E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.
- F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

- A. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.
- D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:
 - 1. Visual and Mechanical Inspection.
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.

- c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.
 - g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- D. Large (Larger Than 167-kVA Single Phase or 500-kVA Three Phase) Dry-Type Transformer Field Tests:
- 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, and grounding.
 - c. Verify that resilient mounts are free and that any shipping brackets have been removed.
 - d. Verify the unit is clean.
 - e. Perform specific inspections and mechanical tests recommended by manufacturer.
 - f. Verify that as-left tap connections are as specified.
 - g. Verify the presence of surge arresters and that their ratings are as specified.
 - 2. Electrical Tests:
 - a. Measure resistance at each winding, tap, and bolted connection.
 - b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
 - c. Perform power-factor or dissipation-factor tests on all windings.
 - d. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
 - e. Perform an excitation-current test on each phase.
 - f. Perform an applied voltage test on all high- and low-voltage windings to ground. See IEEE C57.12.91, Sections 10.2 and 10.9.

- g. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.
- E. Remove and replace units that do not pass tests or inspections and retest as specified above.
- F. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
 - 1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
 - 2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
 - 3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.
- G. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

- A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.
- B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

- A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

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. Service and distribution switchboards rated 600 V and less.
2. Surge protection devices.
3. Disconnecting and overcurrent protective devices.
4. Instrumentation.
5. Control power.
6. Accessory components and features.
7. Identification.

- B. Related Requirements

1. Section 260573.19 "Arc-Flash Hazard Analysis" for arc-flash analysis and arc-flash label requirements.

1.3 ACTION SUBMITTALS

- A. Product Data: For each switchboard, overcurrent protective device, surge protection device, ground-fault protector, accessory, and component.

1. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

- B. Shop Drawings: For each switchboard and related equipment.

1. Contractor to submit electrical studies under 260573.13, 260573.16, and 260573.19, prior submittal for equipment for this specification section. Equipment submittal will be reviewed with approved electrical studies.
2. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings.
3. Detail enclosure types for types other than NEMA 250, Type 1.
4. Detail bus configuration, current, and voltage ratings.
5. Detail short-circuit current rating of switchboards and overcurrent protective devices.

6. Include descriptive documentation of optional barriers specified for electrical insulation and isolation.
7. Detail utility company's metering provisions with indication of approval by utility company.
8. Include evidence of NRTL listing for series rating of installed devices.
9. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
10. Include time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.
11. Include schematic and wiring diagrams for power, signal, and control wiring.

C. Delegated Design Submittal:

1. For protection coordination and short circuit analysis
2. For arc-flash hazard analysis.
3. For arc-flash labels.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Seismic Qualification Data: Certificates, for switchboards, overcurrent protective devices, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field Quality-Control Reports:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals.

1. Include the following:
 - a. Routine maintenance requirements for switchboards and all installed components.

- b. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
- c. Time-current coordination curves for each type and rating of overcurrent protective device included in switchboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device.

1.6 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Potential Transformer Fuses: Equal to 10 percent of quantity installed for each site and type but no fewer than two of each site and type.
 - 2. Control-Power Fuses: Equal to 10 percent of quantity installed for each site and type, but no fewer than two of each site and type.
 - 3. Fuses and Fusible Devices for Fused Circuit Breakers: Equal to 10 percent of quantity installed for each site and type but no fewer than three of each site and type.
 - 4. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each site and type but no fewer than three of each site and type.
 - 5. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each site and type but no fewer than three of each site and type.
 - 6. Indicating Lights: Equal to 10 percent of quantity installed for each site and type but no less than one of each site and type.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers qualified as defined in NEMA PB 2.1 and trained in electrical safety as required by NFPA 70E.
- B. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver switchboards in sections or lengths that can be moved past obstructions in delivery path.
- B. Remove loose packing and flammable materials from inside switchboards and connect factory-installed space heaters to temporary electrical service to prevent condensation.
- C. Handle and prepare switchboards for installation according to NEMA PB 2.1.

1.9 FIELD CONDITIONS

- A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations:

1. Do not deliver or install switchboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above switchboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.

C. Unusual Service Conditions: NEMA PB 2, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

D. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than ten working seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Owner's written permission.
4. Comply with NFPA 70E.

1.10 COORDINATION

- A. Coordinate layout and installation of switchboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace switchboard enclosures, buswork, overcurrent protective devices, accessories, and factory installed interconnection wiring that fail in materials or workmanship within specified warranty period.
 1. Warranty Period: Three years from date of Substantial Completion.

- B. Manufacturer's Warranty: Manufacturer's agrees to repair or replace surge protection devices that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Switchboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 2. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 SWITCHBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; by Schneider Electric.
- B. Source Limitations: Obtain switchboards, overcurrent protective devices, components, and accessories from single source from single manufacturer.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- E. Comply with NEMA PB 2.
- F. Comply with the CEC.
- G. Comply with UL 891.
- H. Front-Connected, Front-Accessible Switchboards:

1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Sections front and rear aligned.
- I. Front- and Side-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Panel mounted.
 3. Section Alignment: Front and Rear aligned.
- J. Front- and Rear-Accessible Switchboards:
1. Main Devices: Fixed, individually mounted.
 2. Branch Devices: Fixed, individually mounted.
 3. Sections front and rear aligned.
- K. Nominal System Voltage: 208Y/120 V.
- L. Main-Bus Continuous: 800 A.
- M. Seismic Requirements: Fabricate and test switchboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation. Shake-table testing shall comply with ICC-ES AC156.
 - a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
 - b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."
- N. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.
- O. Outdoor Enclosures: Type 3R.
1. Finish: Factory-applied finish in manufacturer's standard color; undersurfaces treated with corrosion-resistant undercoating.
 2. Enclosure: Flat roof; bolt-on rear covers for each section, with provisions for padlocking.
 3. Doors: Personnel door at each end of aisle, minimum width of 30 inches; opening outwards; with panic hardware and provisions for padlocking. At least one door shall be sized to permit the largest single switchboard section to pass through without disassembling doors, hinges, or switchboard section.
 4. Accessories: LED luminaires, ceiling mounted; wired to a three-way light switch at each end of aisle; ground-fault circuit interrupter (GFCI) duplex receptacle; emergency battery pack luminaire installed on wall of aisle midway between personnel doors.

- a. Factory-installed electric unit heater(s), wall or ceiling mounted, with integral thermostat and disconnect and with capacities to maintain switchboard interior temperature of 40 deg F with outside design temperature of 0 deg F.
 - b. Factory-installed exhaust fan with capacities to maintain switchboard interior temperature of 100 deg F with outside design temperature of 90 deg F.
 - c. Ventilating openings complete with replaceable fiberglass air filters.
 - d. Thermostat: Single stage; wired to control heat and exhaust fan.
5. Power for Space Heaters, Ventilation, Lighting, and Receptacle: Include a control-power transformer, with spare capacity of 25 percent, within the switchboard. Supply voltage shall be 120 V ac.
- P. Barriers: Between adjacent switchboard sections.
- Q. Insulation and isolation for main bus of main section and main and vertical buses of feeder sections.
- R. Space Heaters: Factory-installed electric space heaters of sufficient wattage in each vertical section to maintain enclosure temperature above expected dew point.
 1. Space-Heater Control: Thermostats to maintain temperature of each section above expected dew point.
 2. Space-Heater Power Source: Transformer, factory installed in switchboard.
- S. Service Entrance Rating: Switchboards intended for use as service entrance equipment shall contain from one to six service disconnecting means with overcurrent protection, a neutral bus with disconnecting link, a grounding electrode conductor terminal, and a main bonding jumper.
- T. Utility Metering Compartment: Barrier compartment and section complying with utility company's requirements; hinged sealable door; buses provisioned for mounting utility company's current transformers and potential transformers or potential taps as required by utility company. If separate vertical section is required for utility metering, match and align with basic switchboard. Provide service entrance label and necessary applicable service entrance features.
- U. Customer Metering Compartment: A separate customer metering compartment and section with front hinged door, and section with front hinged door, for indicated metering, and current transformers for each meter. Current transformer secondary wiring shall be terminated on shorting-type terminal blocks. Include potential transformers having primary and secondary fuses with disconnecting means and secondary wiring terminated on terminal blocks.
- V. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.
- W. Removable, Hinged Rear Doors and Compartment Covers: Secured by standard bolts, for access to rear interior of switchboard.
- X. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.
- Y. Pull Box on Top of Switchboard:

1. Adequate ventilation to maintain temperature in pull box within same limits as switchboard.
2. Set back from front to clear circuit-breaker removal mechanism.
3. Removable covers shall form top, front, and sides. Top covers at rear shall be easily removable for drilling and cutting.
4. Bottom shall be insulating, fire-resistive material with separate holes for cable drops into switchboard.
5. Cable supports shall be arranged to facilitate cabling and adequate to support cables indicated, including those for future installation.

. Buses and Connections: Three phase, four wire unless otherwise indicated.

1. Provide phase bus arrangement A, B, C from front to back, top to bottom, and left to right when viewed from the front of the switchboard.
2. Phase- and Neutral-Bus Material: Hard-drawn copper of 98 percent conductivity, silver-plated.
3. Copper feeder circuit-breaker line connections.
4. Load Terminals: Insulated, rigidly braced, runback bus extensions, of same material as through buses, equipped with mechanical connectors for outgoing circuit conductors. Provide load terminals for future circuit-breaker positions at full-ampere rating of circuit-breaker position.
5. Ground Bus: 1/4-by-2-inch- hard-drawn copper of 98 percent conductivity, equipped with mechanical connectors for feeder and branch-circuit ground conductors.
6. Main-Phase Buses and Equipment-Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.
7. Disconnect Links:
 - a. Isolate neutral bus from incoming neutral conductors.
 - b. Bond neutral bus to equipment-ground bus for switchboards utilized as service equipment or separately derived systems.
8. Neutral Buses: 100 percent of the ampacity of phase buses unless otherwise indicated, equipped with mechanical connectors for outgoing circuit neutral cables. Brace bus extensions for busway feeder neutral bus.
9. Isolation Barrier Access Provisions: Permit checking of bus-bolt tightness.

AA. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

BB. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components including instruments and instrument transformers.

CC. All exterior switchboards shall be anti-corrosive and suitable for marine environment.

2.3 SURGE PROTECTION DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Advanced Protection Technologies Inc. (APT).
2. Eaton.
3. General Electric Company.
4. Siemens Industry, Inc., Energy Management Division.
5. Square D; by Schneider Electric.

B. SPDs: Comply with UL 1449, Type 1.

C. Features and Accessories:

1. Indicator light display for protection status.
2. Form-C contacts rated at 5 A and 250-V ac, one normally open and one normally closed, for remote monitoring of protection status. Contacts shall reverse on failure of any surge diversion module or on opening of any current-limiting device. Coordinate with building power monitoring and control system.
3. Surge counter.

D. Peak Surge Current Rating: The minimum single-pulse surge current withstand rating per phase shall not be less than 300 kA. The peak surge current rating shall be the arithmetic sum of the ratings of the individual MOVs in a given mode.

E. Protection modes and UL 1449 VPR for grounded wye circuits with 208Y/120 V, three-phase, four-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V for 208Y/120 V.
2. Line to Ground: 1200 V for 208Y/120 V.
3. Line to Line: 1000 V for 208Y/120 V.

F. Protection modes and UL 1449 VPR for 240/120 V, single-phase, three-wire circuits shall not exceed the following:

1. Line to Neutral: 700 V.
2. Line to Ground: 1000 V.
3. Line to Line: 1000 V.

G. SCCR: Equal or exceed 100 kA.

H. Nominal Rating: 20 kA.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.

3. Electronic trip circuit breakers with rms sensing; field-replaceable rating plug or field-replicable electronic trip; and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short-time pickup levels.
 - c. Long and short time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker; trip activation on fuse opening or on opening of fuse compartment door.
6. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
7. Ground-Fault Equipment Protection (GFEP) Circuit Breakers: Class B ground-fault protection (30-mA trip).
8. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
 - c. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge (HID) lighting circuits.
 - d. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - e. One-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - f. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - g. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - h. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 - i. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
- B. Insulated-Case Circuit Breaker (ICCB): 100 percent rated, sealed, insulated-case power circuit breaker with interrupting capacity rating to meet available fault current.
 1. Fixed circuit-breaker mounting.
 2. Two-step, stored-energy closing.
 3. Standard-function, microprocessor-based trip units with interchangeable rating plug, trip indicators, and the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Time adjustments for long- and short-time pickup.

- c. Ground-fault pickup level, time delay, and I squared t response.
 - 4. one-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 - 5. Remote trip indication and control.
 - 6. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - 7. Control Voltage: 120-V ac.
- C. Bolted-Pressure Contact Switch: Operating mechanism uses rotary-mechanical-bolting action to produce and maintain high clamping pressure on the switch blade after it engages the stationary contacts.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Boltswitch, Inc.
 - b. Eaton.
 - c. Siemens Industry, Inc., Energy Management Division.
 - d. Square D.
 - 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 - 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 - 4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 - 5. Service-Rated Switches: Labeled for use as service equipment.
 - 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
 - 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- D. High-Pressure, Butt-Type Contact Switch: Operating mechanism uses butt-type contacts and a spring-charged mechanism to produce and maintain high-pressure contact when switch is closed.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. General Electric Company.
 2. Main-Contact Interrupting Capability: Minimum of 12 times the switch current rating.
 3. Operating Mechanism: Manual handle operation to close switch; stores energy in mechanism for opening and closing.
 - a. Electrical Trip: Operation of lever or push-button trip switch, or trip signal from ground-fault relay or remote-control device, causes switch to open.
 - b. Mechanical Trip: Operation of mechanical lever, push button, or other device causes switch to open.
 4. Auxiliary Switches: Factory installed, SPDT, with leads connected to terminal block, and including one set more than quantity required for functional performance indicated.
 5. Service-Rated Switches: Labeled for use as service equipment.
 6. Ground-Fault Relay: Comply with UL 1053; self-powered type with mechanical ground-fault indicator, test function, tripping relay with internal memory, and three-phase current transformer/sensor.
 - a. Configuration: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - b. Internal Memory: Integrates the cumulative value of intermittent arcing ground-fault currents and uses the effect to initiate tripping.
 - c. No-Trip Relay Test: Permits ground-fault simulation test without tripping switch.
 - d. Test Control: Simulates ground fault to test relay and switch (or relay only if "no-trip" mode is selected).
 7. Open-Fuse Trip Device: Arranged to trip switch open if a phase fuse opens.
- E. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- F. Fuses are specified in Section 262813 "Fuses."

2.5 INSTRUMENTATION

- A. Instrument Transformers: NEMA EI 21.1, and the following:
1. Potential Transformers: NEMA EI 21.1; 120 V, 60 H \square single secondary; disconnecting type with integral fuse mountings. Burden and accuracy shall be consistent with connected metering and relay devices.
 2. Current Transformers: NEMA EI 21.1; 5 A, 60 H \square secondary; wound type; single secondary winding and secondary shorting device. Burden and accuracy shall be consistent with connected metering and relay devices.
 3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kVA.

4. Current Transformers for Neutral and Ground-Fault Current Sensing: Connect secondary wiring to ground overcurrent relays, via shorting terminals, to provide selective tripping of main and tie circuit breaker. Coordinate with feeder circuit-breaker, ground-fault protection.
- B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:
 1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:
 - a. Phase Currents, Each Phase: Plus or minus 0.5 percent.
 - b. Phase-to-Phase Voltages, Three Phase: Plus or minus 0.5 percent.
 - c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 0.5 percent.
 - d. Megawatts: Plus or minus 1 percent.
 - e. Megavars: Plus or minus 1 percent.
 - f. Power Factor: Plus or minus 1 percent.
 - g. Frequency: Plus or minus 0.1 percent.
 - h. Accumulated Energy, Megawatt Hours: Plus or minus 1 percent; accumulated values unaffected by power outages up to 72 hours.
 - i. Megawatt Demand: Plus or minus 1 percent; demand interval programmable from five to 60 minutes.
 - j. Contact devices to operate remote impulse-totalizing demand meter.
 2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.6 CONTROL POWER

- A. Control Circuits: 120-V ac, supplied through secondary disconnecting devices from control-power transformer.
- B. Electrically Interlocked Main and Tie Circuit Breakers: Two control-power transformers in separate compartments, with interlocking relays, connected to the primary side of each control-power transformer at the line side of the associated main circuit breaker. 120-V secondaries connected through automatic transfer relays to ensure a fail-safe automatic transfer scheme.
- C. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.
- D. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.

2.7 IDENTIFICATION

- A. Presentation Media: Painted graphics in color contrasting with background color to represent bus and components, complete with lettered designations.

- B. Service Equipment Label: NRTL labeled for use as service equipment for switchboards with one or more service disconnecting and overcurrent protective devices.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store switchboards according to NEMA PB 2.1.
 - 1. Lift or move panelboards with spreader bars and manufacturer-supplied lifting straps following manufacturer's instructions.
 - 2. Use rollers, slings, or other manufacturer-approved methods if lifting straps are not furnished.
 - 3. Protect from moisture, dust, dirt, and debris during storage and installation.
 - 4. Install temporary heating during storage per manufacturer's instructions.
- B. Examine switchboards before installation. Reject switchboards that are moisture damaged or physically damaged.
- C. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance of the Work or that affect the performance of the equipment.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install switchboards and accessories according to NEMA PB 2.1.
- B. Equipment Mounting: Install switchboards on concrete base, 4-inch nominal thickness. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install conduits entering underneath the switchboard, entering under the vertical section where the conductors will terminate. Install with couplings flush with the concrete base. Extend 2 inches above concrete base after switchboard is anchored in place.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to switchboards.
 - 6. Anchor switchboard to building structure at the top of the switchboard if required or recommended by the manufacturer.
- C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, straps and brackets, and temporary blocking of moving parts from switchboard units and components.

- D. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.
- F. Install filler plates in unused spaces of panel-mounted sections.
- G. Install overcurrent protective devices, surge protection devices, and instrumentation.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- H. Install spare-fuse cabinet.
- I. Comply with NECA 1.

3.3 CONNECTIONS

- A. Bond conduits entering underneath the switchboard to the equipment ground bus with a bonding conductor sized per the CEC.
- B. Support and secure conductors within the switchboard according to the CEC.
- C. Extend insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3.4 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- B. Switchboard Nameplates: Label each switchboard compartment with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- C. Device Nameplates: Label each disconnecting and overcurrent protective device and each meter and control device mounted in compartment doors with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

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

- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Tests and Inspections:
 - 1. Acceptance Testing:
 - a. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit. Open control and metering circuits within the switchboard, and remove neutral connection to surge protection and other electronic devices prior to insulation test. Reconnect after test.
 - b. Test continuity of each circuit.
 - 2. Test ground-fault protection of equipment for service equipment per the CEC.
 - 3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
 - 4. Correct malfunctioning units on-site where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 5. Perform the following infrared scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front and rear panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switchboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
 - 6. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- D. Switchboard will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports, including a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.6 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.7 PROTECTION

- A. Temporary Heating: Apply temporary heat, to maintain temperature according to manufacturer's written instructions, until switchboard is ready to be energized and placed into service.

3.8 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories, and to use and reprogram microprocessor-based trip, monitoring, and communication units.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

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. Distribution panelboards.
 - 2. Lighting and appliance branch-circuit panelboards.
 - 3. Load centers.
 - 4. Electronic-grade panelboards.

1.3 DEFINITIONS

- A. ATS: Acceptance testing specification.
- B. GFCI: Ground-fault circuit interrupter.
- C. GFEP: Ground-fault equipment protection.
- D. HID: High-intensity discharge.
- E. MCCB: Molded-case circuit breaker.
- F. SPD: Surge protective device.
- G. VPR: Voltage protection rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of panelboard.
 - 1. Include materials, switching and overcurrent protective devices, SPDs, accessories, and components indicated.
 - 2. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.

1. Contractor to submit electrical studies under 260573.13, 260573.16, and 260573.19, prior submittal for equipment for this specification section. Equipment submittal will be reviewed with approved electrical studies.
2. Include dimensioned plans, elevations, sections, and details.
3. Show tabulations of installed devices with nameplates, conductor termination sizes, equipment features, and ratings.
4. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
5. Detail bus configuration, current, and voltage ratings.
6. Short-circuit current rating of panelboards and overcurrent protective devices.
7. Include evidence of NRTL listing for SPD as installed in panelboard.
8. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
9. Include wiring diagrams for power, signal, and control wiring.
10. Key interlock scheme drawing and sequence of operations.
11. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards. Submit on translucent log-log graph paper; include selectable ranges for each type of overcurrent protective device. Include an Internet link for electronic access to downloadable PDF of the coordination curves.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For testing agency.
- B. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.
- C. Delegated Design Submittal:
 1. For protection coordination and short circuit analysis
 2. For arc-flash hazard analysis.
- D. For arc-flash labels.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:
 1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
 2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Keys: Two spares for each type of panelboard cabinet lock.
 - 2. Circuit Breakers Including GFCI and GFEP Types: Two spares for each panelboard.
 - 3. Fuses for Fused Switches: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 - 4. Fuses for Fused Power-Circuit Devices: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.8 QUALITY ASSURANCE

- A. Manufacturer Qualifications: ISO 9001 or ISO 9002 certified.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Remove loose packing and flammable materials from inside panelboards; install temporary electric heating (250 W per panelboard) to prevent condensation.
- B. Handle and prepare panelboards for installation according to NEMA PB 1.

1.10 FIELD CONDITIONS

- A. Environmental Limitations:
 - 1. Do not deliver or install panelboards until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above panelboards is complete, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.
 - 2. Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Not exceeding 23 deg F to plus 104 deg F.
 - b. Altitude: Not exceeding 6600 feet.
- B. Service Conditions: NEMA PB 1, usual service conditions, as follows:
 - 1. Ambient temperatures within limits specified.
 - 2. Altitude not exceeding 6600 feet.
- C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager and Owner no fewer than ten working days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without Owner's written permission.
3. Comply with NFPA 70E.

1.11 WARRANTY

- A. Manufacturer's Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.
 1. Panelboard Warranty Period: 18 months from date of Substantial Completion.
- B. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace SPD that fails in materials or workmanship within specified warranty period.
 1. SPD Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS AND LOAD CENTERS COMMON REQUIREMENTS

- A. Fabricate and test panelboards according to IEEE 344 to withstand seismic forces defined in Section 260548.16 "Seismic Controls for Electrical Systems."
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for panelboards including clearances between panelboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- D. Comply with NEMA PB 1.
- E. Comply with the CEC.
- F. Enclosures: Flush and Surface-mounted, dead-front cabinets.
 1. Rated for environmental conditions at installed location.
 - a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
 - b. Outdoor Locations: NEMA 250, Type 3R.
 - c. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
 - d. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
 2. Height: 84 inches maximum.

3. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box. Trims shall cover all live parts and shall have no exposed hardware.
4. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.
5. Skirt for Surface-Mounted Panelboards: Same gage and finish as panelboard front with flanges for attachment to panelboard, wall, and ceiling or floor.
6. Gutter Extension and Barrier: Same gage and finish as panelboard enclosure; integral with enclosure body. Arrange to isolate individual panel sections.
7. Finishes:
 - a. Panels and Trim: Steel and galvanized steel, factory finished immediately after cleaning and pretreating with manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat.
 - b. Back Boxes: Galvanized steel.
 - c. Fungus Proofing: Permanent fungicidal treatment for overcurrent protective devices and other components.

G. Incoming Mains:

1. Location: Convertible between top and bottom.
2. Main Breaker: Main lug interiors up to 400 amperes shall be field convertible to main breaker.

H. Phase, Neutral, and Ground Buses:

1. Material: Hard-drawn copper, 98 percent conductivity.
 - a. Plating shall run entire length of bus.
 - b. Bus shall be fully rated the entire length.
2. Interiors shall be factory assembled into a unit. Replacing switching and protective devices shall not disturb adjacent units or require removing the main bus connectors.
3. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment grounding conductors; bonded to box.
4. Extra-Capacity Neutral Bus: Neutral bus rated 200 percent of phase bus and listed and labeled by an NRTL acceptable to authority having jurisdiction, as suitable for nonlinear loads in electronic-grade panelboards and others designated on Drawings. Connectors shall be sized for double-sized or parallel conductors as indicated on Drawings. Do not mount neutral bus in gutter.
5. Split Bus: Vertical buses divided into individual vertical sections.

I. Conductor Connectors: Suitable for use with conductor material and sizes.

1. Material: Hard-drawn copper, 98 percent conductivity.
2. Terminations shall allow use of 75 deg C rated conductors without derating.
3. Size: Lugs suitable for indicated conductor sizes, with additional gutter space, if required, for larger conductors.

4. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
 5. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
 6. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
 7. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.
 8. Gutter-Tap Lugs: Mechanical type suitable for use with conductor material and with matching insulating covers. Locate at same end of bus as incoming lugs or main device.
 9. Extra-Capacity Neutral Lugs: Rated 200 percent of phase lugs mounted on extra-capacity neutral bus.
- J. NRTL Label: Panelboards or load centers shall be labeled by an NRTL acceptable to authority having jurisdiction for use as service equipment with one or more main service disconnecting and overcurrent protective devices. Panelboards or load centers shall have meter enclosures, wiring, connections, and other provisions for utility metering. Coordinate with utility company for exact requirements.
- K. Future Devices: Panelboards or load centers shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.
1. Percentage of Future Space Capacity: 10 percent.
- L. Panelboard Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream overcurrent protective devices and labeled by an NRTL. Include label or manual with size and type of allowable upstream and branch devices listed and labeled by an NRTL for series-connected short-circuit rating.
1. Panelboards rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- M. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
1. Panelboards and overcurrent protective devices rated 240 V or less shall have short-circuit ratings as shown on Drawings, but not less than 10,000 A rms symmetrical.
 2. Panelboards and overcurrent protective devices rated above 240 V and less than 600 V shall have short-circuit ratings as shown on Drawings, but not less than 14,000 A rms symmetrical.
- N. All exterior panelboards shall be anti-corrosive and suitable for marine environment.

2.2 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Panelboards shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
- B. Surge Suppression: Factory installed as an integral part of indicated panelboards, complying with UL 1449 SPD Type 1.

2.3 POWER PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. ESL Power Systems, Inc.
 - 3. General Electric Company; GE Energy Management - Electrical Distribution.
 - 4. Mersen USA.
 - 5. Siemens Industry, Inc., Energy Management Division.
 - 6. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, distribution type.
- C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
 - 1. For doors more than 36 inches high, provide two latches, keyed alike.
- D. Mains: Circuit breaker.
- E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes 125 A and Smaller: Plug-in circuit breakers.
- F. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.
- G. Branch Overcurrent Protective Devices: Fused switches.
- H. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
 - 2. External Control-Power Source: 120-V branch circuit.

2.4 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Contactors in Main Bus: NEMA ICS 2, Class A, electrically held, general-purpose controller, with same short-circuit interrupting rating as panelboard.
 - 1. Internal Control-Power Source: Control-power transformer, with fused primary and secondary terminals, connected to main bus ahead of contactor connection.
- F. Doors: Door-in-door construction with concealed hinges; secured with multipoint latch with tumbler lock; keyed alike. Outer door shall permit full access to the panel interior. Inner door shall permit access to breaker operating handles and labeling, but current carrying terminals and bus shall remain concealed.

2.5 LOAD CENTERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Eaton.
 - 2. General Electric Company; GE Energy Management - Electrical Distribution.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Load Centers: Comply with UL 67.
- C. Mains: Circuit breaker.
- D. Branch Overcurrent Protective Devices: Plug-in circuit breakers, replaceable without disturbing adjacent units.
- E. Doors: Concealed hinges secured with flush latch with tumbler lock; keyed alike.
- F. Conductor Connectors: Mechanical type for main, neutral, and ground lugs and buses.

2.6 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton.
 2. General Electric Company; GE Energy Management - Electrical Distribution.
 3. Siemens Industry, Inc., Energy Management Division.
 4. Square D; by Schneider Electric.
- B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
1. Thermal-Magnetic Circuit Breakers:
 - a. Inverse time-current element for low-level overloads.
 - b. Instantaneous magnetic trip element for short circuits.
 - c. Adjustable magnetic trip setting for circuit-breaker frame sizes 225 A and larger.
 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
 3. Electronic Trip Circuit Breakers:
 - a. RMS sensing.
 - b. Field-replaceable rating plug or electronic trip.
 - c. Digital display of settings, trip targets, and indicated metering displays.
 - d. Multi-button keypad to access programmable functions and monitored data.
 - e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
 - f. Integral test jack for connection to portable test set or laptop computer.
 - g. Field-Adjustable Settings:
 - 1) Instantaneous trip.
 - 2) Long- and short-time pickup levels.
 - 3) Long and short time adjustments.
 - 4) Ground-fault pickup level, time delay, and I squared T response.
 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.
 5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).
 6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).
 7. Arc-Fault Circuit Interrupter Circuit Breakers: Comply with UL 1699; 120/240-V, single-pole configuration.
 8. Subfeed Circuit Breakers: Vertically mounted.
 9. MCCB Features and Accessories:
 - a. Standard frame sizes, trip ratings, and number of poles.
 - b. Breaker handle indicates tripped status.
 - c. UL listed for reverse connection without restrictive line or load ratings.

- d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
 - e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
 - f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.
 - g. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
 - h. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
 - i. Rating Plugs: Three-pole breakers with ampere ratings greater than 150 amperes shall have interchangeable rating plugs or electronic adjustable trip units.
 - j. Auxiliary Contacts: Two, SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts and "b" contacts operate in reverse of circuit-breaker contacts.
 - k. Alarm Switch: Single-pole, normally open contact that actuates only when circuit breaker trips.
 - l. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 - m. One-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function with other upstream or downstream devices.
 - n. Multipole units enclosed in a single housing with a single handle or factory assembled to operate as a single unit.
 - o. Handle Padlocking Device: Fixed attachment, for locking circuit-breaker handle in on or off position.
 - p. Handle Clamp: Loose attachment, for holding circuit-breaker handle in on position.
- C. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- 1. Fuses and Spare-Fuse Cabinet: Comply with requirements specified in Section 262813 "Fuses."
 - 2. Fused Switch Features and Accessories:
 - a. Standard ampere ratings and number of poles.
 - b. Mechanical cover interlock with a manual interlock override, to prevent the opening of the cover when the switch is in the on position. The interlock shall prevent the switch from being turned on with the cover open. The operating handle shall have lock-off means with provisions for three padlocks.
 - c. Auxiliary Contacts: Two normally open and normally closed contact(s) that operate with switch handle operation.

2.7 IDENTIFICATION

- A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

- B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.
- C. Circuit Directory: Directory card inside panelboard door, mounted in metal frame with transparent protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.
- D. Circuit Directory: Computer-generated circuit directory mounted inside panelboard door with transparent plastic protective cover.
 - 1. Circuit directory shall identify specific purpose with detail sufficient to distinguish it from all other circuits.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify actual conditions with field measurements prior to ordering panelboards to verify that equipment fits in allocated space in, and comply with, minimum required clearances specified in the CEC.
- B. Receive, inspect, handle, and store panelboards according to NEMA PB 1.1.
- C. Examine panelboards before installation. Reject panelboards that are damaged, rusted, or have been subjected to water saturation.
- D. Examine elements and surfaces to receive panelboards for compliance with installation tolerances and other conditions affecting performance of the Work.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, encumbrances to workspace clearance requirements, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Comply with NECA 1.
- C. Install panelboards and accessories according to NEMA PB 1.1.
- D. Equipment Mounting:

1. Install panelboards on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."
 2. Attach panelboard to the vertical finished or structural surface behind the panelboard.
 3. Comply with requirements for seismic control devices specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from panelboards.
- F. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Mount top of trim 90 inches above finished floor unless otherwise indicated.
- H. Mount panelboard cabinet plumb and rigid without distortion of box.
- I. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.
- J. Mount surface-mounted panelboards to steel slotted supports 1-1/4 inch in depth. Orient steel slotted supports vertically.
- K. Install overcurrent protective devices and controllers not already factory installed.
1. Set field-adjustable, circuit-breaker trip ranges.
 2. Tighten bolted connections and circuit breaker connections using calibrated torque wrench or torque screwdriver per manufacturer's written instructions.
- L. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.
- M. Install filler plates in unused spaces.
- N. Stub four 1-inch empty conduits from panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.
- O. Mount spare fuse cabinet in accessible location.

3.3 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems."
- B. Create a directory to indicate installed circuit loads after balancing panelboard loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

- C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
- E. Install warning signs complying with requirements in Section 260553 "Identification for Electrical Systems" identifying source of remote circuit.

3.4 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections.
 - 1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.
- C. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- D. Tests and Inspections:
 - 1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers and low-voltage surge arrestors stated in NETA ATS, Paragraph 7.6 Circuit Breakers and Paragraph 7.19.1 Surge Arrestors, Low-Voltage. Do not perform optional tests. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
 - 3. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each panelboard. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each panelboard 11 months after date of Substantial Completion.
 - c. Instruments and Equipment:
 - 1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
- E. Panelboards will be considered defective if they do not pass tests and inspections.

- F. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.
- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes. Prior to making circuit changes to achieve load balancing, inform Architect of effect on phase color coding.
 - 1. Measure loads during period of normal facility operations.
 - 2. Perform circuit changes to achieve load balancing outside normal facility operation schedule or at times directed by the Architect. Avoid disrupting services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
 - 3. After changing circuits to achieve load balancing, recheck loads during normal facility operations. Record load readings before and after changing circuits to achieve load balancing.
 - 4. Tolerance: Maximum difference between phase loads, within a panelboard, shall not exceed 20 percent.

3.6 PROTECTION

- A. Temporary Heating: Prior to energizing panelboards, apply temporary heat to maintain temperature according to manufacturer's written instructions.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

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. Standard-grade receptacles, 125 V, 20 A.
 - 2. USB receptacles.
 - 3. GFCI receptacles, 125 V, 20 A.
 - 4. SPD receptacles, 125 V, 20 A.
 - 5. Hospital-grade receptacles, 125 V, 20 A.
 - 6. Hazardous (classified) location receptacles.
 - 7. Twist-locking receptacles.
 - 8. Pendant cord-connector devices.
 - 9. Cord and plug sets.
 - 10. Toggle switches, 120/277 V, 20 A.
 - 11. Decorator-style devices, 20 A.
 - 12. Occupancy sensors.
 - 13. Digital timer light switches.
 - 14. Residential devices.
 - 15. Wall-box dimmers.
 - 16. Wall plates.
 - 17. Floor service fittings.
 - 18. Poke-through assemblies.
 - 19. Prefabricated multioutlet assemblies.
 - 20. Service poles.

1.3 DEFINITIONS

- A. AFCI: Arc-fault circuit interrupter.
- B. BAS: Building automation system.
- C. EMI: Electromagnetic interference.
- D. GFCI: Ground-fault circuit interrupter.
- E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Floor Service-Outlet Assemblies: One for every 10, but no fewer than one.

2. SPD Receptacles: One for every 10 of each type installed, but no fewer than two of each type.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and use.

B. Comply with the CEC.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with requirements in this Section.

F. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

G. Device Color:

1. Wiring Devices Connected to Normal Power System: White unless otherwise indicated or required by the CEC or device listing.
2. SPD Devices: Blue.

H. Wall Plate Color: For plastic covers, match device color.

I. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

B. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498 and FS W-C-596.

5. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" Article.

C. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with the CEC, "Receptacles in Damp or Wet Locations" Article.

D. Tamper- and Weather-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.3 USB RECEPTACLES

A. USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.
3. USB Receptacles: Dual and quad, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
4. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant Duplex and USB Charging Receptacles:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.
3. Line Voltage Receptacles: Two pole, three wire, and self-grounding; NEMA WD 6, Configuration 5-20R.
4. USB Receptacles: Dual USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).
5. Standards: Comply with UL 498, UL 1310, USB 3.0 devices, and FS W-C-596.
6. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Type: Non-feed through.
5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

- a. Hubbell Incorporated; Wiring Device-Kellems.
 - b. Pass & Seymour/Legrand (Pass & Seymour).
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.
 3. Configuration: NEMA WD 6, Configuration 5-20R.
 4. Type: Non-feed through.
 5. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.
 6. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" Article.
- C. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
 3. Configuration: NEMA WD 6, Configuration 5-15R.
 4. Type: Non-feed through.
 5. Standards: Comply with UL 498 and UL 943 Class A.
 6. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 TWIST-LOCKING RECEPTACLES

- A. Twist-Lock, Single Receptacles, 120 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Configuration: NEMA WD 6, Configuration L5-20R.
 3. Standards: Comply with UL 498.
- B. Twist-Lock, Single Receptacles, 250 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Configuration: NEMA WD 6, Configuration L6-20R.
 3. Standards: Comply with UL 498.
- C. Twist-Lock, Single Receptacles, 277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Configuration: NEMA WD 6, Configuration L7-20R.
 3. Standards: Comply with UL 498.
- D. Twist-Lock, Isolated-Ground, Single Receptacles, 125 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.
 3. Configuration: NEMA WD 6, Configuration L5-20R.
 4. Standards: Comply with UL 498.
- E. Description: Matching, locking-type plug and receptacle body connector, heavy-duty grade.
- F. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Eaton (Arrow Hart).
 2. Ericson.
 3. Hubbell Premise Wiring.
 4. Leviton Manufacturing Co., Inc.

5. Pass & Seymour/Legrand (Pass & Seymour).

- G. Configuration: NEMA WD 6, Configurations L5-20P and L5-20R.
- H. Body: Nylon, with screw-open, cable-gripping jaws and provision for attaching external cable grip.
- I. External Cable Grip: Woven wire-mesh type made of high-strength, galvanized-steel wire strand, matched to cable diameter, and with attachment provision designed for corresponding connector.
- J. Standards: Comply with FS W-C-596.

2.6 CORD AND PLUG SETS

- A. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
- B. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
- C. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.7 TOGGLE SWITCHES, 120/277 V, 20 A

- A. Single-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Standards: Comply with UL 20 and FS W-S-896.
- B. Two-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).

2. Comply with UL 20 and FS W-S-896.
- C. Three-Way Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Comply with UL 20 and FS W-S-896.
- D. Four-Way Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Standards: Comply with UL 20 and FS W-S-896.
- E. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 2. Description: Illuminated when switch is on.
 3. Standards: Comply with UL 20 and FS W-S-896.
- F. Lighted Single-Pole Switches, 120/277 V, 20 A:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.

- d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Handle illuminated when switch is on.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- G. Key-Operated, Single-Pole Switches, 120/277 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: Factory-supplied key in lieu of switch handle.
 - 3. Standards: Comply with UL 20 and FS W-S-896.
- H. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: For use with mechanically held lighting contactors.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.
- I. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
 - 2. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.
 - 3. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.8 DECORATOR-STYLE DEVICES, 20 A

A. Decorator Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.

B. Decorator Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.
5. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" Article.

C. Decorator, Tamper- and Weather-Resistant, Duplex Receptacles, 125 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
3. Configuration: NEMA WD 6, Configuration 5-20R.
4. Standards: Comply with UL 498.

5. Marking: Listed and labeled as complying with the CEC, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

D. Decorator Single-Pole Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Comply with UL 20.

E. Decorator Single-Pole Lighted Switches, 120/277 V, 20 A:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Square face illuminated when circuit is switched off.
3. Standards: Comply with UL 20.

2.9 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual (ultrasonic and passive infrared) technology.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Adjustable time delay of five minutes.
6. Able to be locked to Automatic-On mode.

7. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.
8. Connections: Provisions for connection to BAS.
9. Connections: RJ-45 communications outlet.
10. Connections: Integral wireless networking.

B. Wall Sensor Light Switch, Passive Infrared:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Industries.
 - b. Hubbell Premise Wiring.
 - c. Leviton Manufacturing Co., Inc.
 - d. Pass & Seymour/Legrand (Pass & Seymour).
2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using passive infrared technology.
3. Standards: Comply with UL 20.
4. Connections: Hard wired.
5. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
6. Integral relay for connection to BAS.
7. Adjustable time delay of five minutes.
8. Able to be locked to Automatic-On mode.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

C. Wall Sensor Light Switch, Ultrasonic:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
2. Description: Switchbox-mounted, combination, lighting-control sensor and conventional switch lighting-control unit using ultrasonic technology.
3. Standards: Comply with UL 20.
4. Connections: Integral wireless networking.
5. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
6. Integral relay for connection to BAS.
7. Adjustable time delay of five minutes.
8. Able to be locked to Automatic-On mode.
9. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc.

2.10 TIMER LIGHT SWITCH

A. Digital Timer Light Switch:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Incorporated; Wiring Device-Kellems.
 - c. Leviton Manufacturing Co., Inc.
2. Description: Switchbox-mounted, combination digital timer and conventional switch lighting-control unit, with backlit digital display, with selectable time interval in 10-minute increments.
3. Standards: Comply with UL 20.
4. Rated 960 W at 120 V ac for tungsten lighting, 10 A at 120 V ac or 10 A at 277 V ac for fluorescent or LED lighting, and 1/4 hp at 120 V ac.
5. Integral relay for connection to BAS.

2.11 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.

B. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Smooth, high-impact thermoplastic.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

D. Antimicrobial Cover Plates:

1. Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.
2. Tarnish resistant.

2.12 FLOOR SERVICE FITTINGS

A. Flush-Type Floor Service Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 - d. Wiremold / Legrand.
2. Description: Type: Modular, flush-type, dual-service units suitable for wiring method used, with cover flush with finished floor.
 3. Compartments: Barrier separates power from voice and data communication cabling.
 4. Service Plate and Cover: Rectangular, solid brass with satin finish.
 5. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.
- B. Flap-Type Service Fittings:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Eaton (Arrow Hart).
 - b. Hubbell Premise Wiring.
 - c. Thomas & Betts Corporation; A Member of the ABB Group.
 2. Description: Type: Modular, flap-type, dual-service units suitable for wiring method used, with flaps flush with finished floor.
 3. Compartments: Barrier separates power from voice and data communication cabling.
 4. Flaps: Rectangular, solid brass with satin finish.
 5. Service Plate: Same finish as flaps.
 6. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

2.13 POKE-THROUGH ASSEMBLIES

- A. Description: Factory-fabricated and -wired assembly of below-floor junction box with multichanneled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Hubbell Incorporated; Wiring Device-Kellems.
 2. Pass & Seymour/Legrand (Pass & Seymour).
 3. Square D; by Schneider Electric.
 4. Wiremold / Legrand.
- C. Standards: Comply with scrub water exclusion requirements in UL 514.
- D. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness.
- E. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

- F. Closure Plug: Arranged to close unused 4-inch cored openings and reestablish fire rating of floor.

2.14 PREFABRICATED MULTIOUTLET ASSEMBLIES

- A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.
- B. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Hubbell Incorporated; Wiring Device-Kellems.
 - 2. Wiremold / Legrand.
- C. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.
- D. Raceway Material: Metal, with manufacturer's standard finish.
- E. Multioutlet Harness:
 - 1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.
 - 2. Receptacle Spacing: 6 inches.
 - 3. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
- B. Coordination with Other Trades:
 - 1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes, and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
 - 2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
 - 3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
 - 4. Install wiring devices after all wall preparation, including painting, is complete.
- C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall comply with the CEC, Article 300, without pigtails.
4. Existing Conductors:
 - a. Cut back and pigtail, or replace all damaged conductors.
 - b. Straighten conductors that remain and remove corrosion and foreign matter.
 - c. Pigtailling existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.
2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Verify that dimmers used for fan-speed control are listed for that application.
3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device, listing conditions in the written instructions.

- H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.
- I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

- A. Install non-feed-through GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

- A. Comply with Section 260553 "Identification for Electrical Systems."
- B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

- A. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
 - 1. In healthcare facilities, prepare reports that comply with NFPA 99.
 - 2. Test Instruments: Use instruments that comply with UL 1436.
 - 3. Test Instrument for Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.
- B. Tests for Receptacles:
 - 1. Line Voltage: Acceptable range is 105 to 132 V.
 - 2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
 - 3. Ground Impedance: Values of up to 2 ohms are acceptable.
 - 4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
 - 5. Using the test plug, verify that the device and its outlet box are securely mounted.
 - 6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault-current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.
- C. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 40 lb.
- D. Wiring device will be considered defective if it does not pass tests and inspections.

- E. Prepare test and inspection reports.

END OF SECTION 262726

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. Cartridge fuses rated 600 V ac and less for use in the following:
 - a. Control circuits.
 - b. Motor-control centers.
 - c. Panelboards.
 - d. Switchboards.
 - e. Enclosed controllers.
 - f. Enclosed switches.
2. Spare-fuse cabinets.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:
 1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
 2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 3. Current-limitation curves for fuses with current-limiting characteristics.
 4. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse. Submit in electronic format suitable for use in coordination software.
 5. Coordination charts and tables and related data.
 6. Fuse schedules for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
1. Ambient temperature adjustment information.
 2. Current-limitation curves for fuses with current-limiting characteristics.
 3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse used on the Project. Submit in electronic format suitable for use in coordination software.
 4. Coordination charts and tables and related data.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 FIELD CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Bussmann, an Eaton business.
 2. Edison; a brand of Bussmann by Eaton.
 3. Littelfuse, Inc.
 4. Mersen USA.
- B. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, current-limiting, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.
 - 1. Type RK-1: 600-V, 1/40- to 600-A rating, 200 kAIC, time delay.
 - 2. Type RK-5: 600-V, 1/40- to 600-A rating, 200 kAIC, time delay.
 - 3. Type CC: 600-V, 1/40- to 30-A rating, 200 kAIC, time delay.
 - 4. Type CD: 600-V, 31- to 60-A rating, 200 kAIC, time delay.
 - 5. Type J: 600-V, 1/40- to 600-A rating, 200 kAIC, time delay.
 - 6. Type L: 600-V, 601- to 6000-A rating, 200 kAIC, time delay.
 - 7. Type T: 250-V, 1/40- to 1200-A rating, 200 kAIC, time delay.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- C. Comply with NEMA FU 1 for cartridge fuses.
- D. Comply with the CEC.
- E. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

2.3 SPARE-FUSE CABINET

- A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.
 - 3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
 - 4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.
- B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

- C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Cartridge Fuses:
 - 1. Service Entrance: Class RK1, time delay.
 - 2. Feeders: Class RK1, fast acting.
 - 3. Motor Branch Circuits: Class RK5, time delay.
 - 4. Large Motor Branch (601-4000 A): Class L, time delay.
 - 5. Power Electronics Circuits: Class J, high speed.
 - 6. Other Branch Circuits: Class RK1, time delay.
 - 7. Control Transformer Circuits: Class CC, time delay, control transformer duty.
 - 8. Provide open-fuse indicator fuses or fuse covers with open fuse indication.

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s) in location shown on the Drawings or as indicated in the field by Owner.

3.4 IDENTIFICATION

- A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information inside of door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION 262813

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Fusible switches.
 - 2. Nonfusible switches.
 - 3. Receptacle switches.
 - 4. Shunt trip switches.
 - 5. Molded-case circuit breakers (MCCBs).
 - 6. Molded-case switches.
 - 7. Enclosures.

1.3 DEFINITIONS

- A. NC: Normally closed.
- B. NO: Normally open.
- C. SPDT: Single pole, double throw.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current ratings (interrupting and withstand, as appropriate).
 - 4. Include evidence of a nationally recognized testing laboratory (NRTL) listing for series rating of installed devices.
 - 5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Data: Certificates, for enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:
 - a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF electronic format.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 - 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
 - 2. Altitude: Not exceeding 6600 feet.

1.10 WARRANTY

- A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Enclosed switches and circuit breakers shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 GENERAL REQUIREMENTS

- A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.
- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by an NRTL, and marked for intended location and application.

- D. Comply with the CEC.

2.3 FUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. ABB Inc.
2. Eaton.
3. General Electric Company.
4. Siemens Industry, Inc., Energy Management Division.
5. Square D; by Schneider Electric.

- B. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses.
6. Lockable handle with capability to accept three padlocks and interlocked with cover in closed position.

- C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.4 NONFUSIBLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Eaton.
2. General Electric Company.
3. Siemens Industry, Inc., Energy Management Division.
4. Square D; by Schneider Electric.

- B. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- C. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- D. Type HD, Heavy Duty, Three Pole, Double Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.
- E. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 - 3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
 - 4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
 - 5. Hookstick Handle: Allows use of a hookstick to operate the handle.
 - 6. Lugs: Mechanical type, suitable for number, size, and conductor material.
 - 7. Service-Rated Switches: Labeled for use as service equipment.

2.5 RECEPTACLE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Eaton.
 - 2. General Electric Company.
 - 3. Siemens Industry, Inc., Energy Management Division.
 - 4. Square D; by Schneider Electric.
- B. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30 A; UL 98 and NEMA KS 1; horsepower rated, with clips or bolt pads to accommodate fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- C. Interlocking Linkage: Provided between the receptacle and switch mechanism to prevent inserting or removing plug while switch is in the on position, inserting any plug other than specified, and turning switch on if an incorrect plug is inserted or correct plug has not been fully inserted into the receptacle.
- D. Receptacle: Polarity, three-phase, four-wire receptacle (fourth wire connected to enclosure ground lug).
- E. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.

2.6 SHUNT TRIP SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Bussmann, an Eaton business.
 2. Littelfuse, Inc.
 3. Mersen USA.
- B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with Class J fuse block and 200-kA interrupting and short-circuit current rating.
- C. Type HD, Heavy-Duty, Three Pole, Single-Throw Fusible Switch: 600-V ac, 30 A; UL 98 and NEMA KS 1; integral shunt trip mechanism; horsepower rated, with clips or bolt pads to accommodate indicated fuses; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.
- D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power transformer of enough capacity to operate shunt trip, pilot, indicating and control devices.
- E. Accessories:
1. Oiltight key switch for key-to-test function.
 2. Oiltight green ON pilot light.
 3. Isolated neutral lug; 100 percent rating.
 4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.
 5. Form C alarm contacts that change state when switch is tripped.
 6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.
 7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.
 8. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
 9. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
 10. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

11. Auxiliary Contact Kit: Two NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open. Contact rating - 120-V ac.
12. Hookstick Handle: Allows use of a hookstick to operate the handle.
13. Lugs: Mechanical type, suitable for number, size, and conductor material.
14. Service-Rated Switches: Labeled for use as service equipment.

2.7 MOLDED-CASE CIRCUIT BREAKERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Eaton.
 2. General Electric Company.
 3. NOARK Electric North America.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; by Schneider Electric.
- B. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.
- C. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.
- D. MCCBs shall be equipped with a device for locking in the isolated position.
- E. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F temperature rating in the CEC.
- F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- G. Thermal-Magnetic Circuit Breakers: Inverse time-current thermal element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
- H. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
- I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:
 1. Instantaneous trip.
 2. Long- and short-time pickup levels.
 3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I-squared t response.
- J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.
- K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
- L. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).
- M. Features and Accessories:
 1. Standard frame sizes, trip ratings, and number of poles.
 2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
 3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
 4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 7. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
 8. Alarm Switch: One NO contact that operates only when circuit breaker has tripped.
 9. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.
 10. One-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.
 11. Electrical Operator: Provide remote control for on, off, and reset operations.
 12. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.8 MOLDED-CASE SWITCHES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 1. Eaton.
 2. General Electric Company.
 3. NOARK Electric North America.
 4. Siemens Industry, Inc., Energy Management Division.
 5. Square D; by Schneider Electric.
- B. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

- C. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.
- D. Features and Accessories:
 - 1. Standard frame sizes and number of poles.
 - 2. Lugs:
 - a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
 - b. Lugs shall be suitable for 194 deg F rated wire, sized according to the 167 deg F temperature rating in the CEC.
 - 3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
 - 4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
 - 5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
 - 6. Auxiliary Contacts: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic switch contacts, "b" contacts operate in reverse of switch contacts.
 - 7. Alarm Switch: One NO contact that operates only when switch has tripped.
 - 8. Key Interlock Kit: Externally mounted to prohibit switch operation; key shall be removable only when switch is in off position.
 - 9. One-Selective Interlocking: Integral with ground-fault shunt trip unit; for interlocking ground-fault protection function.
 - 10. Electrical Operator: Provide remote control for on, off, and reset operations.
 - 11. Accessory Control Power Voltage: Integrally mounted, self-powered; 120-V ac.

2.9 ENCLOSURES

- A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.
- B. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.
- C. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover. The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.
- D. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

- E. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

- A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:
 - 1. Notify Construction Manager and Owner no fewer than ten working days in advance of proposed interruption of electric service.
 - 2. Indicate method of providing temporary electric service.
 - 3. Do not proceed with interruption of electric service without Owner's written permission.
 - 4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

- A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
 - 1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
 - 2. Outdoor Locations: NEMA 250, Type 3R.
 - 3. Kitchen or Wash-Down Areas: NEMA 250, Type 4X, stainless steel.
 - 4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

- A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

- B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
- C. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- D. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- E. Install fuses in fusible devices.
- F. Comply with the CEC and NECA 1.

3.5 IDENTIFICATION

- A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Tests and Inspections for Switches:
 - 1. Visual and Mechanical Inspection:
 - a. Inspect physical and mechanical condition.
 - b. Inspect anchorage, alignment, grounding, and clearances.
 - c. Verify that the unit is clean.
 - d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
 - e. Verify that fuse sizes and types match the Specifications and Drawings.
 - f. Verify that each fuse has adequate mechanical support and contact integrity.
 - g. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.
 - a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

- 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.
 - i. Verify correct phase barrier installation.
 - j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.
 - e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

E. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:
 - a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.
 - b. Inspect physical and mechanical condition.
 - c. Inspect anchorage, alignment, grounding, and clearances.
 - d. Verify that the unit is clean.
 - e. Operate the circuit breaker to ensure smooth operation.
 - f. Inspect bolted electrical connections for high resistance using one of the two following methods:
 - 1) Use a low-resistance ohmmeter.

- a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.
 - 2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
 - a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.
 - g. Inspect operating mechanism, contacts, and chutes in unsealed units.
 - h. Perform adjustments for final protective device settings in accordance with the coordination study.
2. Electrical Tests:
- a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
 - c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
 - d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
 - e. Determine the following by primary current injection:
 - 1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
 - 3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.

- 4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
- f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
- g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.
- h. Verify correct operation of auxiliary features such as trip and pickup indicators; ☐one interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.
- i. Verify operation of charging mechanism. Investigate units that do not function as designed.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
4. Perform the following infrared scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.
- F. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.
- G. Prepare test and inspection reports.
 1. Test procedures used.
 2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
 3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

- A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

- B. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

END OF SECTION 262816

SECTION 262923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

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 separately enclosed, preassembled, combination VFCs, rated 600 V and less, for speed control of three-phase, squirrel-cage induction motors.

1.3 DEFINITIONS

- A. CPT: Control power transformer.
- B. DDC: Direct digital control.
- C. EMI: Electromagnetic interference.
- D. LED: Light-emitting diode.
- E. NC: Normally closed.
- F. NO: Normally open.
- G. OCPD: Overcurrent protective device.
- H. PID: Control action, proportional plus integral plus derivative.
- I. RFI: Radio-frequency interference.
- J. VFC: Variable-frequency motor controller.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of VFC indicated.
 - 1. Include dimensions and finishes for VFCs.
 - 2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For each VFC indicated.

1. Include mounting and attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Required working clearances and required area above and around VFCs.
2. Show VFC layout and relationships between electrical components and adjacent structural and mechanical elements.
3. Show support locations, type of support, and weight on each support.
4. Indicate field measurements.

B. Qualification Data: For testing agency.

C. Seismic Qualification Data: Certificates, for each VFC, accessories, and components, from manufacturer.

1. Certificate of compliance.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based, and their installation requirements.

D. Product Certificates: For each VFC from manufacturer.

E. Harmonic Analysis Report: Provide Project-specific calculations and manufacturer's statement of compliance with IEEE 519.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing and adjusting thermal-magnetic circuit breaker and motor-circuit protector trip settings.
 - b. Manufacturer's written instructions for setting field-adjustable overload relays.
 - c. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - d. Manufacturer's written instructions for setting field-adjustable timers, controls, and status and alarm points.
 - e. Load-Current and Overload-Relay Heater List: Compile after motors have been installed, and arrange to demonstrate that selection of heaters suits actual motor nameplate, full-load currents.
 - f. Load-Current and List of Settings of Adjustable Overload Relays: Compile after motors have been installed, and arrange to demonstrate that switch settings for motor-running overload protection suit actual motors to be protected.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.
 2. Control Power Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than two of each size and type.
 3. Indicating Lights: Two of each type and color installed.
 4. Auxiliary Contacts: Furnish one spare(s) for each size and type of magnetic controller installed.
 5. Power Contacts: Furnish three spares for each size and type of magnetic contactor installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Accredited by NETA.
 1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. If stored in space that is not permanently enclosed and air conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

- B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between VFCs, and adjacent surfaces and other items.

1.10 WARRANTY

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. ABB, Electrification Products Division.
 - 2. Eaton.
 - 3. GE.
 - 4. Schneider Electric USA, Inc.
 - 5. Honeywell

2.2 SYSTEM DESCRIPTION

- A. General Requirements for VFCs:
 - 1. VFCs and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Comply with NEMA ICS 7, NEMA ICS 61800-2, and UL 508C.
- B. VFC Description: Variable-frequency motor controller, consisting of power converter that employs pulse-width-modulated inverter, factory built and tested in an enclosure, with integral disconnecting means and overcurrent and overload protection; listed and labeled by an NRTL as a complete unit; arranged to provide self-protection, protection, and variable-speed control of one or more three-phase induction motors by adjusting output voltage and frequency.
 - 1. Units suitable for operation of NEMA MG 1, Design A and Design B motors, as defined by NEMA MG 1, Section IV, Part 30, "Application Considerations for Constant Speed Motors Used on a Sinusoidal Bus with Harmonic Content and General Purpose Motors Used with Adjustable-Voltage or Adjustable-Frequency Controls or Both."
 - 2. Units suitable for operation of inverter-duty motors as defined by NEMA MG 1, Section IV, Part 31, "Definite-Purpose Inverter-Fed Polyphase Motors."
 - 3. Listed and labeled for integrated short-circuit current (withstand) rating by an NRTL acceptable to authorities having jurisdiction.

- C. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.
- D. Output Rating: Three phase; 10 to 60 H \square with voltage proportional to frequency throughout voltage range; maximum voltage equals input voltage.
- E. Unit Operating Requirements:
 - 1. Input AC Voltage Tolerance: Plus 10 and minus 10 percent of VFC input voltage rating.
 - 2. Input AC Voltage Unbalance: Not exceeding 3 percent.
 - 3. Input Frequency Tolerance: Plus or minus 3 percent of VFC frequency rating.
 - 4. Minimum Efficiency: 97 Insert number percent at 60 H \square full load.
 - 5. Minimum Displacement Primary-Side Power Factor: 98 Insert number percent under any load or speed condition.
 - 6. Minimum Short-Circuit Current (Withstand) Rating: 65 kA.
 - 7. Ambient Temperature Rating: Not less than 32 deg F and not exceeding 104 deg F.
 - 8. Humidity Rating: Less than 95 percent (noncondensing).
 - 9. Altitude Rating: Not exceeding 3300 feet.
 - 10. Vibration Withstand: Comply with NEMA ICS 61800-2.
 - 11. Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
 - 12. Starting Torque: Minimum 100 percent of rated torque from 3 to 60 H \square
 - 13. Speed Regulation: Plus or minus [] [10] percent.
 - 14. Output Carrier Frequency: Selectable; 0.5 to 15 kHz
 - 15. Stop Modes: Programmable; includes fast, free-wheel, and dc injection braking.
- F. Inverter Logic: Microprocessor based, 32 bit, isolated from all power circuits.
- G. Isolated Control Interface: Allows VFCs to follow remote-control signal over a minimum 40:1 speed range.
 - 1. Signal: Electrical Pneumatic.
- H. Internal Adjustability Capabilities:
 - 1. Minimum Speed: 5 to 25 percent of maximum rpm.
 - 2. Maximum Speed: 80 to 100 percent of maximum rpm.
 - 3. Acceleration: [0.1 to 999.] seconds.
 - 4. Deceleration: 0.1 to 999.9 seconds.
 - 5. Current Limit: 30 to minimum of 150 percent of maximum rating.
- I. Self-Protection and Reliability Features:
 - 1. Surge Suppression: Factory installed as an integral part of the VFC, complying with UL 1449 SPD, Type 1 or Type 2.
 - 2. Loss of Input Signal Protection: Selectable response strategy, including speed default to a percent of the most recent speed, a preset speed, or stop; with alarm.
 - 3. Under- and overvoltage trips.
 - 4. Inverter overcurrent trips.

5. VFC and Motor-Overload/Overtemperature Protection: Microprocessor-based thermal protection system for monitoring VFCs and motor thermal characteristics, and for providing VFC overtemperature and motor-overload alarm and trip; settings selectable via the keypad.
 6. Critical frequency rejection, with three selectable, adjustable deadbands.
 7. Instantaneous line-to-line and line-to-ground overcurrent trips.
 8. Loss-of-phase protection.
 9. Reverse-phase protection.
 10. Short-circuit protection.
 11. Motor-overtemperature fault.
- J. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts.
- K. Power-Interruption Protection: To prevent motor from re-energizing after a power interruption until motor has stopped, unless "Bidirectional Autospeed Search" feature is available and engaged.
- L. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.
- M. Torque Boost: Automatically varies starting and continuous torque to at least 1.5 times the minimum torque to ensure high-starting torque and increased torque at slow speeds.
- N. Motor Temperature Compensation at Slow Speeds: Adjustable current fall-back based on output frequency for temperature protection of self-cooled, fan-ventilated motors at slow speeds.
- O. Integral Input Disconnecting Means and OCPD: UL 489, thermal-magnetic circuit breaker with pad-lockable, door-mounted handle mechanism.
1. Disconnect Rating: Not less than 115 percent of NFPA 70 motor full-load current rating or VFC input current rating, whichever is larger.
 2. Auxiliary Contacts: NO or NC, arranged to activate before switch blades open.
 3. Auxiliary contacts "a" and "b" arranged to activate with circuit-breaker handle.
 4. NO alarm contact that operates only when circuit breaker has tripped.

2.3 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: VFCs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated VFCs shall be tested and certified by an NRTL as meeting the ICC-ES AC 156 test procedure requirements.
1. The term "withstand" means "the unit will remain in place without separation of any parts when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.4 CONTROLS AND INDICATION

- A. Status Lights: Door-mounted LED indicators displaying the following conditions:
1. Power on.
 2. Run.
 3. Overvoltage.
 4. Line fault.
 5. Overcurrent.
 6. External fault.
- B. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English-language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
1. Keypad: In addition to required programming and control keys, include keys for HAND, OFF, and AUTO modes.
 2. Security Access: Provide electronic security access to controls through identification and password with at least three levels of access: View only; view and operate; and view, operate, and service.
 - a. Control Authority: Supports at least four conditions: Off, local manual control at VFC, local automatic control at VFC, and automatic control through a remote source.
- C. Historical Logging Information and Displays:
1. Real-time clock with current time and date.
 2. Running log of total power versus time.
 3. Total run time.
 4. Fault log, maintaining last four faults with time and date stamp for each.
- D. Indicating Devices: Digital display and additional readout devices as required, mounted flush in VFC door and connected to display VFC parameters including, but not limited to:
1. Output frequency (Hz).
 2. Motor speed (rpm).
 3. Motor status (running, stop, fault).
 4. Motor current (amperes).
 5. Motor torque (percent).
 6. Fault or alarming status (code).
 7. PID feedback signal (percent).
 8. DC-link voltage (V dc).
 9. Set point frequency (Hz).
 10. Motor output voltage (V ac).
- E. Control Signal Interfaces:
1. Electric Input Signal Interface:

- a. A minimum of two programmable analog inputs: 0- to 10-V dc 4- to 20-mA dc Operator-selectable "x"- to "y"-mA dc.
 - b. A minimum of six multifunction programmable digital inputs.
 2. Remote Signal Inputs: Capability to accept any of the following speed-setting input signals from the DDC system for HVAC or other control systems:
 - a. 0- to 10-V dc.
 - b. 4- to 20-mA dc.
 - c. Potentiometer using up/down digital inputs.
 - d. Fixed frequencies using digital inputs.
 3. Output Signal Interface: A minimum of one programmable analog output signal(s) (0- to 10-V dc 4- to 20-mA dc operator-selectable "x"- to "y"-mA dc), which can be configured for any of the following:
 - a. Output frequency (Hz).
 - b. Output current (load).
 - c. DC-link voltage (V dc).
 - d. Motor torque (percent).
 - e. Motor speed (rpm).
 - f. Set point frequency (Hz).
 4. Remote Indication Interface: A minimum of two programmable dry-circuit relay outputs (120-V ac, 1 A) for remote indication of the following:
 - a. Motor running.
 - b. Set point speed reached.
 - c. Fault and warning indication (overtemperature or overcurrent).
 - d. PID high- or low-speed limits reached.
- F. PID Control Interface: Provides closed-loop set point, differential feedback control in response to dual feedback signals. Allows for closed-loop control of fans and pumps for pressure, flow, or temperature regulation.
 1. Number of Loops: One.
- G. Interface with DDC System for HVAC: Factory-installed hardware and software shall interface with DDC system for HVAC to monitor, control, display, and record data for use in processing reports. VFC settings shall be retained within VFC's nonvolatile memory.
 1. Hardwired Points:
 - a. Monitoring: On-off status,.
 - b. Control: On-off operation,.
 2. Communication Interface: Comply with ASHRAE 135. Communication shall interface with DDC system for HVAC to remotely control and monitor lighting from a DDC system for HVAC operator workstation. Control features and monitoring points displayed locally at lighting panel shall be available through the DDC system for HVAC.

2.5 LINE CONDITIONING AND FILTERING

- A. Input Line Conditioning: Based on the manufacturer's harmonic analysis study and report, provide input filtering, as required, to limit total demand (harmonic current) distortion and total harmonic voltage demand at the defined point of common coupling to meet IEEE 519 recommendations.
- B. Output Filtering: .
- C. EMI/RFI Filtering: CE marked; certify compliance with IEC 61800-3 for Category C2 **Insert category** .

2.6 BYPASS SYSTEMS

- A. Bypass Operation: Safely transfers motor between power converter output and bypass circuit, manually, automatically, or both. Selector switches set modes and indicator lights indicate mode selected. Unit is capable of stable operation (starting, stopping, and running) with motor completely disconnected from power converter.
- B. Bypass Mode: Field-selectable automatic or manual, allows local and remote transfer between power converter and bypass contactor and retransfer, either via manual operator interface or automatic-control system feedback.
- C. Bypass Controller: Two-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter and permit safe troubleshooting and testing, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
 - 2. Output Isolating Contactor: Non-load-break, NEMA-rated contactor.
- D. Bypass Controller: Three-contactor-style bypass allows motor operation via the power converter or the bypass controller; with input isolating switch and barrier arranged to isolate the power converter input and output and permit safe testing and troubleshooting of the power converter, both energized and de-energized, while motor is operating in bypass mode.
 - 1. Bypass Contactor: Load-break, NEMA-rated contactor.
 - 2. Input and Output Isolating Contactors: Non-load-break, NEMA-rated contactors.
 - 3.
- E. Bypass Contactor Configuration: Reduced-voltage (autotransformer) type.
 - 1. NORMAL/BYPASS selector switch.
 - 2. HAND/OFF/AUTO selector switch.
 - 3. NORMAL/TEST Selector Switch: Allows testing and adjusting of VFC while the motor is running in the bypass mode.
 - 4. Contactor Coils: Pressure-encapsulated type with coil transient suppressors.

- a. Operating Voltage: Depending on contactor NEMA size and line-voltage rating, manufacturer's standard matching control power or line voltage.
 - b. Power Contacts: Totally enclosed, double break, and silver-cadmium oxide; assembled to allow inspection and replacement without disturbing line or load wiring.
5. Control Circuits: 120-V ac; obtained from integral CPT, with primary and secondary fuses, with CPT control power source of sufficient capacity to operate all integral devices and remotely located pilot, indicating, and control devices.
- a. CPT Spare Capacity: 250 VA.
6. Overload Relays: NEMA ICS 2.
- a. Solid-State Overload Relays:
 - 1) Switch or dial selectable for motor-running overload protection.
 - 2) Sensors in each phase.
 - 3) Class 10/20 selectable tripping characteristic selected to protect motor against voltage and current unbalance and single phasing.
 - 4) Class II ground-fault protection, with start and run delays to prevent nuisance trip on starting.
 - 5) Analog communication module.
 - b. NO isolated overload alarm contact.
 - c. External overload, reset push button.

2.7 OPTIONAL FEATURES

- A. Multiple-Motor Capability: VFC suitable for variable-speed service to multiple motors. Overload protection shuts down VFC and motors served by it, and generates fault indications when overload protection activates.
 - 1. Configure to allow two motors to operate simultaneously and in a lead/lag mode, with one motor operated at variable speed via the power converter and the other at constant speed via the bypass controller; separate overload relay for each controlled motor.
- B. Damper control circuit with end-of-travel feedback capability.
- C. Sleep Function: Senses a minimal deviation of a feedback signal and stops the motor. On an increase in speed-command signal deviation, VFC resumes normal operation.
- D. Motor Preheat Function: Preheats motor when idle to prevent moisture accumulation in the motor.
- E. Remote Indicating Circuit Terminals: Mode selection, controller status, and controller fault.
- F. Remote digital operator kit.

- G. Communication Port: RS-232 port, USB 2.0 port, or equivalent connection capable of connecting a printer and a notebook computer.

2.8 ENCLOSURES

- A. VFC Enclosures: NEMA 250, to comply with environmental conditions at installed location.
 - 1. Dry and Clean Indoor Locations: Type 1.
 - 2. Outdoor Locations: Type 3R.
 - 3. Kitchen Wash-Down Areas: Type 4X, stainless steel.
 - 4. Other Wet or Damp Indoor Locations: Type 4.
 - 5. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: Type 12.
- B. Plenum Rating: UL 1995; NRTL certification label on enclosure, clearly identifying VFC as "Plenum Rated."

2.9 ACCESSORIES

- A. General Requirements for Control-Circuit and Pilot Devices: NEMA ICS 5; factory installed in VFC enclosure cover unless otherwise indicated.
 - 1. Push Buttons: Shielded.
 - 2. Pilot Lights: Push to test.
 - 3. Selector Switches: Rotary type.
 - 4. Stop and Lockout Push-Button Station: Momentary-break, push-button station with a factory-applied hasp arranged so padlock can be used to lock push button in depressed position with control circuit open.
- B. Reversible NC/NO bypass contactor auxiliary contact(s).
- C. Control Relays: Auxiliary and adjustable solid-state time-delay relays.
- D. Phase-Failure, Phase-Reversal, and Undervoltage and Overvoltage Relays: Solid-state sensing circuit with isolated output contacts for hard-wired connections. Provide adjustable undervoltage, overvoltage, and time-delay settings.
 - 1. Current Transformers: Continuous current rating, basic impulse insulating level (BIL) rating, burden, and accuracy class suitable for connected circuitry. Comply with IEEE C57.13.
- E. Supplemental Digital Meters:
 - 1. Elapsed-time meter.
 - 2. Kilowatt meter.
 - 3. Kilowatt-hour meter.

- F. Breather and drain assemblies, to maintain interior pressure and release condensation in NEMA 250, Type 4 enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- G. Space heaters, with NC auxiliary contacts, to mitigate condensation in NEMA 250, Type 3R enclosures installed outdoors or in unconditioned interior spaces subject to humidity and temperature swings.
- H. Cooling Fan and Exhaust System: For NEMA 250, Type 1; UL 508 component recognized: Supply fan, with stainless-steel intake and exhaust grills and filters; 120-V ac; obtained from integral CPT.
- I. Sun shields installed on fronts, sides, and tops of enclosures installed outdoors and subject to direct and extended sun exposure.
- J. Spare control-wiring terminal blocks; unwired.

2.10 SOURCE QUALITY CONTROL

- A. Testing: Test and inspect VFCs according to requirements in NEMA ICS 61800-2.
 - 1. Test each VFC while connected to its specified motor.
 - 2. Verification of Performance: Rate VFCs according to operation of functions and features specified.
- B. VFCs will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance of the Work.
- B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
- C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.
- D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Wall-Mounting Controllers: Install with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished floor, unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For controllers not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- B. Floor-Mounting Controllers: Install VFCs on 4-inch nominal thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
 - 3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- C. Roof-Mounting Controllers: Install VFC on roofs with tops at uniform height and with disconnect operating handles not higher than 79 inches above finished roof surface unless otherwise indicated, and by bolting units to curbs or mounting on freestanding, lightweight, structural-steel channels bolted to curbs. Seal roof penetrations after raceways are installed.
 - 1. Curbs and roof penetrations are specified in Section 077200 "Roof Accessories."
 - 2. Structural-steel channels are specified in Section 260529 "Hangers and Supports for Electrical Systems."
- D. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- E. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- F. Install fuses in each fusible-switch VFC.
- G. Install fuses in control circuits if not factory installed. Comply with requirements in Section 262813 "Fuses."
- H. Install heaters in thermal-overload relays. Select heaters based on actual nameplate full-load amperes after motors are installed.
- I. Install, connect, and fuse thermal-protector monitoring relays furnished with motor-driven equipment.
- J. Comply with NECA 1.

3.3 CONTROL WIRING INSTALLATION

- A. Install wiring between VFCs and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."
- B. Bundle, train, and support wiring in enclosures.
- C. Connect selector switches and other automatic-control devices where applicable.
 - 1. Connect selector switches to bypass only those manual- and automatic-control devices that have no safety functions when switches are in manual-control position.
 - 2. Connect selector switches with control circuit in both manual and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor-overload protectors.

3.4 IDENTIFICATION

- A. Identify VFCs, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label each VFC with engraved nameplate.
 - 3. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for VFCs, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of VFC units.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections with the assistance of a factory-authorized service representative.
- D. Acceptance Testing Preparation:
 - 1. Test insulation resistance for each VFC element, bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- E. Tests and Inspections:

1. Inspect VFC, wiring, components, connections, and equipment installation. Test and adjust controllers, components, and equipment.
2. Test insulation resistance for each VFC element, component, connecting motor supply, feeder, and control circuits.
3. Test continuity of each circuit.
4. Verify that voltages at VFC locations are within 10 percent of motor nameplate rated voltages. If outside this range for any motor, notify Architect Construction Manager Owner before starting the motor(s).
5. Test each motor for proper phase rotation.
6. Perform tests according to the Inspection and Test Procedures for Adjustable Speed Drives stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections, and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each VFC. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each VFC 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. VFCs will be considered defective if they do not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.6 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.7 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

- B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.
- C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Owner before increasing settings.
- D. Set the taps on reduced-voltage autotransformer controllers.
- E. Set field-adjustable circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."
- F. Set field-adjustable pressure switches.

3.8 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.9 DEMONSTRATION

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

END OF SECTION 262923

SECTION 263323.11 - CENTRAL BATTERY EQUIPMENT FOR EMERGENCY LIGHTING

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. Interruptible (fast-transfer) central battery equipment.
 - 2. Enclosures.
 - 3. Optional and accessory features.

1.3 DEFINITIONS

- A. DDC: Direct digital control.
- B. IBC: International Building Code.
- C. Interruptible: As used in the Section Text, an off-line, passive-standby or line-interactive, inverter-only unit, with an intentional interruption of power to the load until an internal transfer switch picks up and transfers the load to the unit's inverter and internal battery source on loss of the "normal" source, and then retransfers to the "normal" source when it is restored. Transfer time can be "slow" (up to approximately 1 second) or "fast" (2-4 ms or 40-50 ms, depending on manufacturer).
- D. LED: Light-emitting diode.
- E. Low Voltage: As defined in the CEC for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
- F. NiCd: Nickel cadmium.
- G. OCPD: Overcurrent protective device.
- H. PC: Personal computer.
- I. PWM: Pulse-width modulated.
- J. TDD: Total demand (harmonic current) distortion (also listed as "THD" in catalog data by manufacturers).

- K. THD(V): Total harmonic voltage demand.
- L. Uninterruptible: As used in the Section Text, an on-line, double-conversion (rectifier/inverter) unit, with no interruption of power to the load on interruption and restoration of the "normal" source.
- M. UPS: Uninterruptible power supply.
- N. VRLA: Valve-regulated lead acid.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type and rating of central battery equipment unit.
 - 1. Include features, performance, electrical ratings, operating characteristics, shipping and operating weights, shipping splits, and furnished options, specialties, and accessories.
- B. Shop Drawings: For each type and rating of central battery equipment unit.
 - 1. Include plans, elevations, sections, and mounting details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, ventilation requirements, method of field assembly, components, and location and size of each field connection.
 - 3. Include system one-line diagram, internal and interconnecting wiring; and diagrams for power, signal, and control wiring.
 - 4. Include elevation, details, and legends of control and indication displays.
 - 5. Include -circuit current (withstand) rating of unit.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Floor plans, drawn to scale, showing dimensioned layout, required working clearances, and required area above and around central battery equipment. Show central battery equipment layout and relationships between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.
- B. Qualification Data: For Installer and testing agency.
- C. Seismic Qualification Data: For central battery equipment, accessories, and components, from manufacturer.
 - 1. Certificate of compliance.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

- D. Product Certificates: For each type of central battery equipment.
- E. Harmonic Analysis Study and Report: Comply with IEEE 399 and NETA Acceptance Testing Specification; identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze designated operating scenarios, including recommendations for input filtering of central battery equipment to limit TDD and THD(V) to specified levels.
- F. Source quality-control reports.
- G. Field quality-control reports.
- H. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For central battery equipment to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
 - a. Manufacturer's written instructions for testing central battery equipment.
 - b. Manufacturer's written instructions for testing, adjusting, and reprogramming microprocessor control modules.
 - c. Manufacturer's written instructions for selecting and setting field-adjustable controls and status and alarm points

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents. Deliver extra materials to Owner.
 - 1. Fuses: One for every 10 of each type and rating, but no fewer than five of each type.
 - 2. Output Circuit Breakers: One for every 10 of each type and rating, but no fewer than five of each type.
 - 3. Output Circuit Breaker Open/Tripped Alarm Contacts: One for every 10 supplied, but no fewer than five of each type.
 - 4. Cabinet Ventilation Filters: One complete set.
 - 5. Circuit Board: One spare circuit board for each critical circuit.

1.8 QUALITY ASSURANCE

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

- B. Testing Agency Qualifications: Member company of NETA or an NRTL acceptable to authorities having jurisdiction.

- 1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver equipment in fully enclosed vehicles.
- B. Store equipment in spaces having environments controlled within manufacturers' written instructions for ambient temperature and humidity conditions for non-operating equipment.

1.10 FIELD CONDITIONS

- A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - 1. Ambient Temperature: Less than 0 deg F (minus 18 deg C) or exceeding 104 deg F (40 deg C), with an average value exceeding 95 deg F (35 deg C) over a 24-hour period.
 - 2. Ambient Storage Temperature: Not less than minus 4 deg F (minus 20 deg C) and not exceeding 140 deg F (60 deg C).
 - 3. Humidity: More than 95 percent (condensing).
 - 4. Altitude: Exceeding 3300 feet (1000 m).
- B. Interruption of Existing Electrical Distribution Systems: Do not interrupt electrical distribution systems within facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:
 - 1. Notify Architect, Construction Manager, and Owner no fewer than two days in advance of proposed interruption of electrical systems.
 - 2. Indicate method of providing temporary electrical service.
 - 3. Do not proceed with interruption of electrical systems without Construction Manager's and Owner's written permission.
 - 4. Comply with NFPA 70E.
- C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for central battery equipment, including clearances between central battery equipment and adjacent surfaces and other items.

1.11 COORDINATION

- A. Coordinate sizes and locations of concrete bases. Cast anchor-bolt inserts into bases.

1.12 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace central battery equipment that fails in materials or workmanship within specified warranty period. Special warranty, applying to batteries only, applies to materials only, on a prorated basis, for period specified.
 - 1. Warranty Period: Include the following warranty periods, from date of Substantial Completion:
 - a. Central Battery Equipment (excluding Batteries): One year(s).
 - b. Standard VRLA Batteries:
 - 1) Full Warranty: One year(s).
 - 2) Pro Rata: Nine years.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Central battery equipment shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. The designated central battery equipment shall be tested and certified by an NRTL as meeting ICC-ES AC 156 test procedure requirements.
 - 1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2.2 INTERRUPTIBLE (FAST-TRANSFER) CENTRAL BATTERY EQUIPMENT

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Crucial Power
 - 2. Myers
- B. General Requirements for Interruptible (Fast-Transfer) Central Battery Equipment:
 - 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
 - 2. NRTL Compliance: Fabricate and label central battery equipment to comply with UL 924 and UL 1778.
 - 3. Comply with the IBC, the CEC, and NFPA 101.
 - 4. Comply with NEMA PE 1.
- C. Performance Requirements:

1. Fast-Transfer Central Battery Equipment: Line-interactive (on-line) system. Automatically sense loss of normal ac supply and use a solid-state static switch to transfer load. Transfer in 2-4 ms or less from normal supply to battery-inverter supply.
2. Automatic Operation:
 - a. Normal Conditions: Supply the load with ac power flowing from normal ac power input terminals, bypassing inverter, with battery connected in parallel via rectifier/charger output.
 - b. Abnormal Supply Conditions: If normal ac supply deviates from specified voltage, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
 - c. If normal power fails, transfer switch operates and battery supplies constant, regulated ac power through the inverter to the load, with a momentary loss of power to the load.
 - d. If a fault occurs in system when being supplied by inverter and current flows in excess of the overload rating of inverter, inverter automatically protects itself against damage from overloads and short circuits by shutting down.
 - e. When normal ac power is restored at input supply terminals of unit, controls automatically retransfer the load back to the normal ac supply, with a momentary loss of power to the load. Rectifier/charger then recharges battery.
 - f. If normal power failure is prolonged (more than 90 minutes), integral low-voltage battery protective circuit disconnects battery and prevents battery from damage due to deep discharge.
 - g. If battery becomes discharged, and when normal ac supply is again available, rectifier/charger recharges battery. When battery is fully charged, rectifier/charger automatically shifts to float-charge mode.
 - h. If battery is disconnected, and normal ac power is available, central battery equipment continues to supply power to the load with no degradation of its regulation of voltage and frequency of output bus.

D. Unit Operating Requirements:

1. Input AC Voltage Tolerance: Plus 10 and minus 15 percent of central battery equipment input voltage rating.
2. Input Frequency Tolerance: Plus or minus 3 percent of central battery equipment frequency rating.
3. Synchronizing Slew Rate: 1 Hz per second, maximum.
4. Minimum Off-Line Efficiency: 99 percent at 60 Hz full load.
5. Minimum Displacement Primary-Side Power Factor: 96 percent under any load or operating condition.
6. Ambient Temperature Rating (Other Than Batteries): Not less than 68 deg F (20 deg C) and not exceeding 86 deg F (30 deg C).
7. Ambient Storage Temperature Rating (Other Than Batteries): Not less than minus 4 deg F (minus 20 deg C) and not exceeding 158 deg F (70 deg C).
8. Ambient Temperature Rating (Batteries): Not less than 32 deg F (0 deg C) and not exceeding 104 deg F (40 deg C).
9. Ambient Storage Temperature Rating (Batteries): Not less than 0 deg F (minus 18 deg C) and not exceeding 104 deg F (40 deg C).
10. Humidity Rating: Less than 95 percent (noncondensing).

11. Altitude Rating: Not exceeding 3300 feet (1005 m).
 12. Off-Line Overload Capability: 1.5 times the base load current for 60 seconds; minimum of 1.8 times the base load current for three seconds.
- E. Inverter and Controls Logic: Microprocessor based, isolated from all power circuits; provides complete self-diagnostics, periodic automatic testing and reporting; with alarms.
- F. Controls and Indication:
1. Status Indication: Door-mounted, labeled LED indicators or digital screen displaying the following conditions:
 - a. Normal power available.
 - b. Status of system.
 - c. Battery charging status.
 - d. On battery power.
 - e. System fault.
 - f. External fault.
 2. Panel-Mounted Operator Station: Manufacturer's standard front-accessible, sealed keypad and plain-English language digital display; allows complete programming, program copying, operating, monitoring, and diagnostic capability.
 - a. Keypad: In addition to required programming and control keys, include the following:
 - 1) Keys for METER, CONTROL, PROGRAM, and CLEAR modes.
 - 2) Security Access: Provide electronic security access to controls through identification and password with at least two levels of access: View only; and view, operate, and service.
 - 3) Control Authority: Supports at least three conditions: Off, local manual control at unit and local automatic control at unit.
 - b. Digital Display: Plain-English language messages on a digital display; provide the following historical logging information and displays:
 - 1) Real-time clock with current time and date.
 - 2) Tests and Events Logs: Record and store up to 50 tests and events.
 - a) Dates.
 - b) Times.
 - c) Durations.
 - d) Output voltage and currents.
 - 3) Alarm Logs: Record and store up to 25 alarms.
 - a) Dates.
 - b) Times.
 - c) Alarm type.

- 4) Metering Functions: Display central battery equipment metering parameters including, but not limited to, the following:
 - a) Input and output voltage (V ac) and output current (A ac).
 - b) Battery voltage (V dc) and current (A ac).
 - c) Fault or alarming status (code).
 - d) Power output (VA).
 - e) Inverter load (W).
 - f) Ambient temperature (deg F).
 - g) System run time (cumulative days).
 - h) Inverter run time (cumulative minutes).
 - 5) Alarm Functions: Digital display mounted flush in unit door and connected to display central battery equipment parameters including, but not limited to, the following:
 - a) High/low battery charge voltage.
 - b) High/low input voltage.
 - c) Battery nearing low-voltage condition.
 - d) Battery low voltage.
 - e) High ambient temperature.
 - f) Inverter fault.
 - g) Output fault.
 - h) Output overload.
3. Remote Signal Interfaces:
- a. Remote Indication Interface: A minimum of one programmable (Form C) dry-circuit relay output(s) (120-V ac, 2 A) for remote indication of the following:
 - 1) Fault or status indication.
 - 2) On bypass.
 - 3) Low battery.
 - b. Communications Interface: Factory-installed hardware and software to enable a remote PC to program central battery equipment and monitor and display status and alarms.
 - 1) Communications Ports: RS-485.
 - 2) Network Communications Ports: Ethernet RS-485.
 - 3) Compliance with ASHRAE 135: Controllers shall support serial MS/TP and Ethernet IP communications, and shall be able to communicate directly via DDC system for HVAC RS-485 serial networks and Ethernet 10Base-T networks as a native device.

G. Self-Protection and Reliability Features:

1. Input transient protection by means of surge suppressors to provide protection against damage from supply voltage surges as defined in IEEE C62.45, Category B and C.

2. Integral, programmable, self-diagnostic and self-test circuitry; with alarms and logging.
 3. Battery deep-discharge and self-discharge protection; with alarms.
 4. Battery self-test circuitry; with alarms and logging.
- H. Integral Input Disconnecting Means and OCPD: Thermal-magnetic circuit breaker, complying with UL 489.
1. Integrated Equipment Minimum Short-Circuit Current (Withstand) Rating: 22 kA.
- I. Inverter:
1. Description: Solid-state, high-frequency, PWM type, with the following operational features:
 - a. Automatically regulate output voltage to within plus or minus 3 percent, for all load ranges and for maximum 25 percent step-load changes; regulation may increase to 8 percent for 100 percent step-load changes.
 - b. Automatically regulate output frequency to within plus or minus 1 Hz from no load to full load, at unity power factor, over the operating range of battery voltage.
 - c. Output Voltage Waveform: Sine wave with maximum 3 percent TDD throughout battery operating-voltage range, for 100 percent linear load.
 - d. Inverter Overload Capability: 115 percent for 10 minutes; 150 percent surge for 10 seconds.
 - e. Load Power Factor: 0.5 lead to 0.5 lag.
 - f. Brownout Protection: Produces rated power without draining batteries when input voltage is down to 75 percent of normal.
- J. Rectifier/Battery Charger:
1. Description: Solid state, variable rate, temperature compensated; automatically maintains batteries in fully charged condition when normal power is available.
 2. Maximum Battery Recharge Time from Fully Discharged State: 24 hours.
 3. Low-voltage disconnect circuit reduces battery discharge during extended power outages, monitors battery voltage, and disconnects inverter when battery voltage drops to no less than 85.7 percent of nominal voltage.
- K. Batteries:
1. Description: Standard VRLA batteries.
 - a. Capable of sustaining full-capacity output of inverter unit for minimum of 90 minutes.
 2. Battery Disconnect and OCPD: Manufacturer's standard.
- L. Maintenance Bypass Systems:
1. Maintenance Bypass Mode:

- a. Internal; manual operation only; bypasses central battery equipment power circuits (inverter and static transfer switch); requires local operator selection at central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities.
 - b. External; manual operation only; bypasses central battery equipment completely; requires local operator selection at external switch enclosure remote from central battery equipment. Transfer and retransfer shall be make-before-break, without disrupting power to the load or causing system instabilities.
2. Bypass Overload Capability: 1.5 times the base load current.

M. Integral Output Disconnecting Means and OCPD:

1. Single-Output OCPD: Thermal-magnetic circuit breaker, complying with UL 489; manufacturer's standard ratings based on unit output ratings.
2. Multiple-Output OCPDs: Thermal-magnetic circuit breakers, complying with UL 489; voltage rating matching unit output voltage rating; 20 A, single pole.
 - a. Normally Closed: 2; with trip alarm.
 - b. Normally Open: 2; with trip alarm.

2.3 ENCLOSURES

- A. Central Battery Equipment Enclosures: NEMA 250, to comply with environmental conditions at installed location.
1. Dry and Clean Indoor Locations: Type 1 steel cabinets with access to components through hinged doors with flush tumbler lock and latch.
 2. Finish: Manufacturer's standard baked-enamel finish over corrosion-resistant prime treatment.

2.4 OPTIONAL AND ACCESSORY FEATURES

A. Factory-Installed Options and Accessories:

1. Multiple-Output Voltages: Supply unit branch circuits at different voltage levels if required. Transform voltages internally as required to produce indicated output voltages.
2. Split-Output Configuration: Divides output into normally on and normally off buses.
3. Auto-dialer.
4. Internal fax modem.
5. Audible alarm with silencer switch.
6. Remote Summary Alarm Panel: Labeled LEDs on panel faceplate shall indicate five basic status conditions. Audible signal indicates alarm conditions; silencing switch in face of panel silences signal without altering visual indication.
 - a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.

- b. Maximum Distance from Main Unit: 1000 feet (304 m).
- 7. Remote Meter Panel: Match equipment requirements of remote monitoring, controlling, and programming of central battery equipment.
 - a. Cabinet and Faceplate: Surface or flush mounted to suit mounting conditions indicated.
 - b. Maximum Distance from Main Unit: 150 feet (46 m).

2.5 SOURCE QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to evaluate central battery equipment fabricator's quality-control and testing methods.
- B. Testing: Test and inspect central battery equipment according to UL 924 and UL 1778.
- C. Factory Tests: Test and inspect assembled central battery equipment, by a qualified testing agency, according to UL 924 and UL 1778. Affix standards organization's label. Include the following:
 - 1. Functional test and demonstration of all functions, controls, indicators, sensors, and protective devices.
 - 2. Full-load test.
 - 3. Transient-load response test.
 - 4. Overload test.
 - 5. Power failure test.
- D. Central battery equipment will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Receive, inspect, handle, and store central battery equipment according to NECA 411.
- B. Examine areas, surfaces, and substrates to receive central battery equipment, with Installer present, for compliance with requirements for installation tolerances, structural support, ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment will be installed, before installation begins.

- C. Examine equipment before installation. Reject equipment that is wet, moisture damaged, or mold damaged.
- D. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 HARMONIC ANALYSIS STUDY

- A. Perform a harmonic analysis study to identify the effects of nonlinear loads and their associated harmonic contributions on the voltages and currents throughout the electrical system. Analyze designated operating scenarios, including recommendations for central battery equipment input filtering to limit TDD and THD(V) to specified levels.
- B. Prepare a harmonic analysis study and report complying with IEEE 399 and with NETA Acceptance Testing Specification.

3.3 INSTALLATION

- A. Coordinate layout and installation of central battery equipment with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
- B. Install central battery equipment and accessories according to NECA 411.
- C. Wall-Mounted Central Battery Equipment: Install central battery equipment on walls with tops at uniform height and with disconnect operating handles not higher than 79 inches (2000 mm) above finished floor unless otherwise indicated, and by bolting units to wall or mounting on lightweight structural-steel channels bolted to wall. For units not on walls, provide freestanding racks complying with Section 260529 "Hangers and Supports for Electrical Systems."
- D. Suspended-Mounted Central Battery Equipment: Suspend central battery equipment from structural ceiling components using hangers, clamps, and associated fittings, designed for types and sizes of units to be supported. Provide support devices complying with Section 260529 "Hangers and Supports for Electrical Systems."
- E. Floor-Mounted Central Battery Equipment: Install central battery equipment on 4-inch (100-mm) nominal-thickness concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
 - 2. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

3. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 4. Install anchor bolts to elevations required for proper attachment to supported equipment.
- F. Seismic Bracing: Comply with requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."
- G. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
- H. Comply with NECA 1.
- I. Wiring Methods:
1. Install cables in raceways and cable trays except within consoles, cabinets, desks, counters, accessible ceiling spaces, and gypsum board partitions where unenclosed wiring method may be used.
 2. Conceal raceway and cables except in unfinished spaces.
 3. Provide plenum-rated cable, where installed exposed or in open cable tray, within environmental airspaces, including plenum ceilings.
 4. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
 5. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
- J. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

3.4 CONNECTIONS

- A. Connections: Interconnect system components. Make connections to supply and load circuits according to manufacturer's wiring diagrams unless otherwise indicated.
- B. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
1. Separately Derived Systems: Make grounding connections to grounding electrodes and bonding connections to metallic piping systems as indicated; comply with the CEC.
- C. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.5 INSTALLATION OF CONTROL WIRING

- A. Install wiring between central battery equipment and remote devices and facility's central-control system. Comply with requirements in Section 260523 "Control-Voltage Electrical Power Cables."

- B. Bundle, train, and support wiring in enclosures.

3.6 IDENTIFICATION

- A. Identify central battery equipment, components, and control wiring. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
 - 1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
 - 2. Label central battery equipment with engraved nameplates.
 - 3. Label each separate cabinet, for multicabinet units.
 - 4. Label each enclosure-mounted control and pilot device.
- B. Operating Instructions: Frame printed operating instructions for central battery equipment, including control sequences and emergency procedures. Fabricate frame of finished metal, and cover instructions with clear acrylic plastic. Mount on front of central battery equipment units.

3.7 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- C. Perform tests and inspections.
- D. Acceptance Testing Preparation:
 - 1. Inspect and Test Each Component:
 - a. Inspect wiring, components, connections, and equipment installations. Test and adjust components and equipment.
 - b. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
 - c. Test continuity of each circuit.
- E. Tests and Inspections:
 - 1. Inspect central battery equipment, wiring, components, connections, and equipment installation. Test and adjust components and equipment.
 - 2. Test insulation resistance for all external branch circuit, feeder, control, and alarm wiring connected to central battery equipment element and component.
 - 3. Test continuity of each circuit.
 - 4. Verify that input voltages and frequencies at central battery equipment locations are within voltage and frequency limits specified in Part 2. If outside this range, notify Architect, Construction Manager, and Owner before closing input OCPDs.

5. Perform each visual and mechanical inspection and electrical test stated in manufacturer's written instructions and in NETA Acceptance Testing Specification, including specifically those for batteries, battery chargers, and UPS, regardless of the type of central battery equipment provided. Certify compliance with test parameters.
6. Perform a load-duration test at rated voltage and rated output current to verify the correct functional operation of the unit under full-load stable operating conditions for the minimum time limits required by UL 924. Monitor and record ambient temperature and temperatures within the unit.
7. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
8. Perform the following infrared (thermographic) scan tests and inspections and prepare reports:
 - a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of central battery equipment. Remove front panels so joints and connections are accessible to portable scanner.
 - b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of central battery equipment 11 months after date of Substantial Completion.
 - c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
9. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

F. Central battery equipment will be considered defective if it does not pass tests and inspections.

G. Prepare test and inspection reports, including a certified report that identifies central battery equipment and describes all test results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

3.8 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.

3.9 ADJUSTING

- A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.
- B. Set field-adjustable switches, auxiliary relays, and other adjustable parts.
- C. Adjust the trip settings of thermal-magnetic circuit breakers with adjustable, instantaneous-trip elements; install fuses if not factory installed.

- D. Set the automatic system test parameters.
- E. Set field-adjustable, circuit-breaker trip ranges as specified in Section 260573.16 "Coordination Studies."

3.10 PROTECTION

- A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.
- B. Replace central battery equipment whose interiors have been exposed to water or other liquids prior to Substantial Completion.

3.11 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain central battery equipment, and to use and reprogram microprocessor-based control, monitoring, and display functions.

END OF SECTION 263323.11

SECTION 263373 - BATTERY ENERGY STORAGE SYSTEM (BESS)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

1.03 DEFINITIONS

- A. BESS: Battery energy storage system.
- B. BMS: Battery management system.
- C. HVAC: Heating, ventilation, and air conditioning.
- D. IEC: International Electrotechnical Commission.
- E. IEEE: Institute of Electrical and Electronics Engineers.
- F. kWh: Kilowatt hour.
- G. kW: Kilowatt.
- H. LFP: Lithium ferrophosphate/lithium-ion iron phosphate.
- I. NEC: National Electrical Code.
- J. PCS: Power conversion system.
- K. SOC: State of charge.
- L. UL: Underwriters Laboratories.
- M. C Rate: Power/energy capacity.

1.04 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures; Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. IEC 61800-3 - Adjustable Speed Electrical Power Drive Systems - Part3: EMC Requirements and Specific Test Methods for PDS and Machine Tools; 2022.
- D. IEEE 693 - Recommended Practice for Seismic Design of Substations; 2018.
- E. ISO 9001 - Quality Management Systems — Requirements; 2015, with Amendment (2024).
- F. ISO 12944-5 - Paints and Varnishes – Corrosion Protection of Steel Structures by Protective Paint Systems – Part 5: Protective Paint Systems; 2019.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2020.
- H. NFPA 69 - Standard on Explosion Prevention Systems; 2024.
- I. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. NFPA 855 - Standard for the Installation of Stationary Energy Storage Systems; 2023.
- K. UL 1642 - Lithium Batteries; Current Edition, Including All Revisions.
- L. UL 1741 - Inverters, Converters, Controllers and Interconnection System Equipment for Use With Distributed Energy Resources; Current Edition, Including All Revisions.
- M. UL 1973 - Batteries for Use in Stationary and Motive Auxiliary Power Applications; Current Edition, Including All Revisions.

N.UL 9540 - Energy Storage Systems and Equipment; Current Edition, Including All Revisions.

O.UL 9540A - Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems; Current Edition, Including All Revisions.

1.05 ADMINISTRATIVE REQUIREMENTS

A.Preinstallation Meeting: Review material selections and installation procedures with manufacturer's representative and affected installers.

B. Scheduling: Do not schedule functional demonstration testing until operational readiness testing is complete and associated report and certification have been submitted.

1.05A ACTION SUBMITTALS

A. Product Data: For BESS.

1. **Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for BESS system.**
2. **Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.**

B. Shop Drawings: For BESS.

1. **Include plans, elevations, sections and mounting details.**
2. **Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of field connection.**
3. **Detail fabrication and assembly.**
4. **Include diagrams for power, signal, and control wiring.**

C. **Hazard Mitigation Analysis: Provide Hazard Mitigation Analysis, as applicable, per California Fire Code Section 1207.1.4**

D. **Delegated Design Submittal: For BESS, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.**

1.06 INFORMATIONAL SUBMITTALS

A. Provide sufficient information to determine compliance with Contract Documents. Identify submittal data with specific equipment tags and/or service descriptions to which they pertain. Identify specific model numbers, options, and features of equipment proposed.

B. Indicate deviations from Contract Documents with reference to corresponding drawing or specification.

F. Functional Demonstration Testing Report: Document test results, including assumptions, conditions, allowances, and corrections made. **Testing documentation to comply with DSA IR N-4 section 3.1.5.**

D. Shop Drawings: Indicate enclosure dimensions, shipping section dimensions, weights, foundation requirements, required clearances, location and size of each field connection, and mounting and installation instructions.

1. Structural calculations.
2. Inspection and test plan.

E. Operational Readiness Report:

1. Document test results, including assumptions, conditions, allowances, and corrections made.
2. Provide listing of field modifications and adjustments made including settings/parameters not identified as factory defaults within equipment's operations and maintenance manual documentation.

3. Include certification, signed by Contractor and manufacturer's representative, that equipment and associated system have been installed, configured, and tested in accordance with manufacturer's recommendations, conforms to requirements of Contract Documents, and is ready for operation.
- F. Functional Demonstration Testing Report: Document test results, including assumptions, conditions, allowances, and corrections made. **Testing documentation to comply with DSA IR N-4 section 3.1.5.**
- G. Manufacturer's qualification statement.
- H. Operation and Maintenance Data:
 1. Provide detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - a. Include contact information for parts stocking location closest to Owner.
 - b. Identify critical spare parts associated with long lead times and/or those critical to unit operation.
 - c. Identify maintenance spare parts required to regularly perform scheduled equipment maintenance including, but not limited to, consumable parts required to be exchanged during scheduled maintenance periods.
- I. Project Record Documents:
 1. Construction, installation, schematic, and wiring diagrams updated to as-installed and commissioned state.
 2. Configured settings/parameters for adjustable components updated to as-installed and commissioned state, noted if different from factory default.
- J. Specimen Warranty: Statement of standard warranty.
- K. Executed warranty.
- L. Maintenance Materials: Furnish the following for Owner's use in maintenance of project:
 1. Tools: Manufacturer-specific special tools required to install, remove, test, and maintain equipment components.
 - a. Equipment Configuration Software: PC-based or smart mobile device application; provide one of each different communication interface cable required to connect computer/device for configuration and programming.
 - b. Electronic Configuration Files: For future upload into replaced/repaired components, in media format acceptable by Owner.

1.07 QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70.
 2. NFPA 855.
 3. **DSA IR N-4**
 4. **CFC 1207**
 5. Requirements of local authorities having jurisdiction.
 6. Applicable local codes.
- B. Manufacturer Qualifications:
 1. Certified in accordance with ISO 9001 with applicable quality assurance system regularly reviewed and audited by third-party registrar. Develop and control manufacturing, inspection, and testing procedures under guidelines of quality assurance system.

2. Service, repair, and technical support services available 24 hours per day, 7 days per week from manufacturer or their representative.

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

1.08 DELIVERY, STORAGE, AND HANDLING

A. Prior to delivery to project site, verify suitable storage space is available to store materials in well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity, and corrosive atmospheres.

B. Protect materials during delivery and storage and maintain within manufacturer's written storage requirements. At minimum, store indoors in clean, dry space with uniform temperature to prevent condensation and protect electronics from potential damage from electrical and magnetic energy.

C. Deliver materials to project site in supplier's or manufacturer's original wrappings and containers, labeled with supplier's or manufacturer's name, material or product brand name, and equipment tag number or service name as identified in Contract Documents.

D. Inspect products and report concealed damage or violation of delivery, storage, and handling requirements to Engineer.

E. Provide crane for handling of 20 ft BESS.

F. Energize/charge BESS within 2 weeks after delivery to project site.

1.09 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. Manufacturer Warranty:

1. Provide manufacturer warranty for defects in material and workmanship for 3 years, including performance guarantee, labor, and parts. Complete forms in Owner's name and register with manufacturer.

2. Offer warranty extension for coverage through year 4 for customers that enable remote support.

3. Offer warranty extension for coverage through year 10 for additional cost.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Schneider Electric Battery Energy Storage System (BESS)

B. Approved equal. See Substitutions Section 004325 – Substitution Request Form

2.02 BATTERY ENERGY STORAGE SYSTEMS (BESS)

A. Basis of Design: Schneider Electric Battery Energy Storage System (BESS); www.se.com/#sle.

B. BESS Ratings/Configurations: As indicated on drawings.

C. 7 ft BESS Rating/Configuration: 90 kW, 246 kWh, AC coupled; Model BESS0700900246A

D. Provide battery energy storage system (BESS) units factory assembled in non-walk-in, outdoor-rated only enclosure including but not limited to power conversion system (PCS), lithium-ion iron phosphate/lithium ferrophosphate (LFP) batteries, output isolation transformer, factory-installed local BESS controller for communication with microgrid controls, UPS for control

backup, HVAC system, fire alarm system, gas detection and ventilation system, and factory-installed internal electrical connections.

E. Listed as complying with UL 9540.

F. Seismic Qualification:

1. Provide independent third-party analysis and certification in accordance with ICC (IBC)/ASCE 7 and IEEE 693, using importance factor of 1.0.

G. Fire Safety:

1. UL 9540 certification, which includes UL 9540A large fire battery open rack tests.
2. Dry pipe sprinkler system, requiring first responder water connection.
3. Heat, smoke, and gas sensors.
4. Active ventilation explosion prevention system complying with NFPA 69.

H. Electromagnetic Compatibility: IEC 61800-3.

I. Operation Temperature Range: From minus 4 to 122 degrees F (minus 20 to 50 degrees C).

J. HVAC:

1. Factory-installed packaged HVAC unit, wall mounted, with integral thermostat and disconnect.
2. Capacity: Maintain enclosure interior temperature to battery manufacturer requirements with outside design temperature of minus 4 degrees F (minus 20 degrees C) or 122 degrees F (50 degrees C).

K. Total Harmonic Distortion:

1. Output Current THD (I): 2 percent, maximum.
2. Output Voltage THD (V): 3 percent, maximum.

L. Power Conversion System:

1. Rated Power:
 - a. 7 ft BESS: ~~60 kW and 90 kW models available.~~
2. AC Output Voltage:
 - a. 7 ft BESS: 480 VAC (plus/minus 10 percent), 3 phase, 4 wire.
3. Grid Frequency: 60 Hz, plus/minus 2.5 Hz.
4. DC Bus Voltage Range:
 - a. 7 ft BESS: 350-750 VDC.
5. Control: Droop, virtual synchronous generation, isochronous.
6. Overload Capability:
 - a. 7 ft BESS: 100-110 percent unlimited; 110-120 percent for 10 minutes; 120-150 percent for 200 milliseconds.
7. Current Imbalance: 100 percent.
8. Certifications:
 - a. UL 1741, UL 1741 SA, UL 1741 SB, and UL 1741 CRD.
 - b. California Energy Commission PCS/BESS listed.
9. Four-Quadrant Inverters: Capable of grid-tie and grid-forming operation.

M. Batteries:

1. Chemistry: Lithium-ion iron phosphate/lithium ferrophosphate (LFP).
2. Nominal Capacity:
 - a. Cell: 100 Ah.
 - b. Battery Module: 400 Ah.

3.Nominal Energy:

- a. Cell: 0.32 kWh.
- b. Battery Module: 20.5 kWh.

4.Voltage Range:

- a. Cell: 2.8-3.6 V.
- b. Battery Module: 44.8-57.6 V.

5.Optimize capacity, energy, and voltage range for racks for configuration.

6.C-Rate: 0.5C.

7.Rated Life: 6,000 cycles, 15-20 years; dependent on application and temperature.

8.Certifications:

- a. UL 1642.
- b. UL 1973.
- c. UL 9540A.
- d. United Nations Manual of Tests and Criteria, Section 38.3 (UN 38.3).

N.Communications:

- 1.Protocol: Modbus TCP.
- 2.Ethernet Port: Copper RJ45, maximum 328 feet (100 m).
- 3.Data logging.

O.Enclosure:

- 1.Environmental Rating: NEMA 250, Type 3R.
- 2.Corrosion Resistance: ISO 12944-5, Class C3.
- 3.Dimensions:
 - a. 7 ft BESS: 6.9 feet (2.1 m) long by 4.2 feet (1.3 m) deep by 7.7 feet (2.4 m) high.
- 4.Weight (Battery Loaded):
 - a. 7 ft BESS: Up to 3.6 tons, depending on configuration.

2.03 SOURCE QUALITY CONTROL

- A.Perform factory functional testing and first parameter adjusting.
- B. Identify BESS with label indicating inspection/testing agency and date of service.

PART 3 EXECUTION

3.01 EXAMINATION

- A.Examine equipment exterior and interior for damage, including but not limited to, structure, moisture, and mildew.
- B.Examine for conditions detrimental to completion of work.

3.02 INSTALLATION

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

3.03 FIELD QUALITY CONTROL

- A.Manufacturer Services: Provide services of manufacturer's field representative to perform functional testing, commissioning, and first parameter adjusting.
 - 1.Include necessary material, equipment, labor, and technical supervision.
 - 2.Replace damaged or malfunctioning equipment and report discrepancies or installation issues.
 - 3.Identify BESS with label indicating inspection/testing agency and date of service.
- B. Operational Readiness Testing:

1. Inspect and test equipment and associated systems for conformance to Contract Documents, including equipment manufacturer's recommendations, and readiness for operation.
 - a. Visually inspect for physical damage and proper installation.
 - b. Perform tests in accordance with manufacturer's instructions.
 - c. Perform tests to verify compliance with Contract Documents.
 - d. Perform tests to verify equipment is ready for operation.
 - e. Touch-up paint chips and scratches with manufacturer-supplied paint.

C. Commissioning:

1. Provide commissioning services per:

- a. **Section 01 91 14 "Commissioning Authority Responsibilities"**
- b. **California Fire Code Section 1207.2**
- c. **DSA IR N-4 Section 3.1.12**

3.04 CLOSEOUT ACTIVITIES

A. Functional Demonstration Testing: Demonstrate proper operation of equipment and associated systems to Owner's designated representative, observing and documenting compliance with Contract Documents.

B. Training:

1. Train Owner's personnel on operation and maintenance of system.
 - a. Accommodate minimum of four attendees.
 - b. Provide not less than one session with four hours of classroom and hands-on training.
 - c. Training Reference: Use submitted operations and maintenance manuals.
 - d. Instructor: Factory-trained manufacturer's representative.
 - e. Location: Project site.
2. Provide sufficient time and detail in each session to cover the following at minimum:
 - a. Operation theory.
 - b. Major equipment components.
 - c. Equipment operation.
 - d. Equipment configurations.
 - e. Maintenance, troubleshooting, and repair.
 - f. Component-level parts replacement.

3.05 MAINTENANCE

A. Service Plan: Provide separate maintenance contract to Owner, as proposal in addition to base bid for service and maintenance of BESS for two years from date of Substantial Completion.

1. Annual Preventative Maintenance Visit: Perform inspection of equipment and environment and submit report documenting results with recommendations.

3.06 PROTECTION

A. Protect installed equipment from subsequent construction operations.

END OF SECTION 263373

SECTION 265119 - LED INTERIOR LIGHTING

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 the following types of LED luminaires:
 - 1. Cylinder.
 - 2. Downlight.
 - 3. Recessed, linear.
 - 4. Strip light.
 - 5. Surface mount, linear.
 - 6. Surface mount, nonlinear.
 - 7. Suspended, linear.
 - 8. Suspended, nonlinear.
- B. Related Requirements:
 - 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. LED: Light-emitting diode.
- F. Lumen: Measured output of lamp and luminaire, or both.
- G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.
 - 3. Include physical description and dimensions of luminaires.
 - 4. Include emergency lighting units, including batteries and chargers.
 - 5. Include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 - 6. Photometric data and adjustment factors based on laboratory tests, complying with IES "Lighting Measurements Testing and Calculation Guides" for each luminaire type. The adjustment factors shall be for lamps and accessories identical to those indicated for the luminaire as applied in this Project IES LM-79.
 - a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
- B. Shop Drawings: For nonstandard or custom luminaires.
 - 1. Include plans, elevations, sections, and mounting and attachment details.
 - 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.
- D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.
 - 1. Include Samples of luminaires and accessories involving color and finish selection.
- E. Samples for Verification: For each type of luminaire.
 - 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 - 1. Luminaires.
 - 2. Suspended ceiling components.

3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which equipment and or luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.
6. Items penetrating finished ceiling, including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - f. Ceiling-mounted projectors.
7. Moldings.

B. Qualification Data: For testing laboratory providing photometric data for luminaires.

C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Product Certificates: For each type of luminaire.

E. Product Test Reports: For each type of luminaire, for tests performed by a qualified testing agency.

F. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.

2. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- B. Provide luminaires from a single manufacturer for each luminaire type.
- C. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- D. Mockups: For interior luminaires in room or module mockups, complete with power and control connections.
 1. Obtain Architect's approval of luminaires in mockups before starting installations.
 2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
- B. Warranty Period: Five year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."
- C. Ambient Temperature: 41 to 104 deg F.
 - 1. Relative Humidity: zero to 95 percent.
- D. Altitude: Sea level to 1000 feet.

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage, and coating.
 - c. CCT and CRI.
- C. Recessed luminaires shall comply with NEMA LE 4.
- D. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
- E. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- F. California Title 24 compliant.

2.3 MATERIALS

- A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Steel:

1. ASTM A36/A36M for carbon structural steel.
2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:

1. 1. Manufacturer's standard grade.
2. 2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.

2.4 METAL FINISHES

- A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.5 LUMINAIRE SUPPORT

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.
- C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.
- D. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.
- E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is sufficiently complete, clean luminaires used for temporary lighting and install new lamps.

3.3 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Provide support for luminaire without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- E. Flush-Mounted Luminaires:
 - 1. Secured to outlet box.
 - 2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
 - 3. Trim ring flush with finished surface.
- F. Wall-Mounted Luminaires:
 - 1. Attached to structural members in walls.
 - 2. Do not attach luminaires directly to gypsum board.
- G. Suspended Luminaires:
 - 1. Ceiling Mount:
 - a. Pendant mount with 5/32-inch- diameter aircraft cable supports 10 feet in length.
 - b. Hook mount.
 - 2. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

3. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
4. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
5. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure luminaire to the luminaire opening using approved fasteners in a minimum of four locations, spaced near corners of luminaire.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.4 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

- B. Luminaire will be considered defective if it does not pass operation tests and inspections.

- C. Prepare test and inspection reports.

3.6 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265119

SECTION 265213 - EMERGENCY AND EXIT LIGHTING

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. Emergency lighting units.
 - 2. Exit signs.
 - 3. Luminaire supports.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color Rendering Index.
- C. Emergency Lighting Unit: A lighting unit with internal or external emergency battery powered supply and the means for controlling and charging the battery and unit operation.
- D. Fixture: See "Luminaire" Paragraph.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of emergency lighting unit, exit sign, and emergency lighting support.
 - 1. Include data on features, accessories, and finishes.
 - 2. Include physical description of the unit and dimensions.
 - 3. Battery and charger for light units.
 - 4. Include life, output of luminaire (lumens, CCT, and CRI), and energy-efficiency data.
 - 5. Include photometric data and adjustment factors based on laboratory tests, complying with IES LM-45, for each luminaire type.

- a. Testing Agency Certified Data: For indicated luminaires and signs, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires and signs shall be certified by manufacturer.
 - b. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.
- B. Shop Drawings: For nonstandard or custom luminaires.
 1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each product and for each color and texture specified.
- D. Samples for Initial Selection: For each type of luminaire with factory-applied finishes.
- E. Samples for Verification: For each type of luminaire.
 1. Include Samples of luminaires and accessories to verify finish selection.
- F. Product Schedule:
 1. For emergency lighting units. Use same designations indicated on Drawings.
 2. For exit signs. Use same designations indicated on Drawings.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
 1. Luminaires.
 2. Suspended ceiling components.
 3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
 4. Structural members to which equipment will be attached.
 5. Size and location of initial access modules for acoustical tile.
 6. Items penetrating finished ceiling including the following:
 - a. Other luminaires.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Ceiling-mounted projectors.
 - e. Sprinklers.
 - f. Access panels.

7. Moldings.

- B. Qualification Data: For testing laboratory providing photometric data for luminaires.
- C. Product Certificates: For each type of luminaire.
- D. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
 - 4. Provide seismic qualification certificate for each piece of equipment.
- E. Product Test Reports: For each luminaire for tests performed by a qualified testing agency.
- F. Sample Warranty: For manufacturer's special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and lighting systems to include in emergency, operation, and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Luminaire-mounted, emergency battery pack: One for every 20 emergency lighting units. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.10 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two year(s) from date of Substantial Completion.
- B. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period for Emergency Power Unit Batteries: Five years from date of Substantial Completion. Full warranty shall apply for the entire warranty period.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7. Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 GENERAL REQUIREMENTS FOR EMERGENCY LIGHTING

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.

- B. NRTL Compliance: Fabricate and label emergency lighting units, exit signs, and batteries to comply with UL 924.
- C. Comply with the CEC and NFPA 101.
- D. Comply with NEMA LE 4 for recessed luminaires.
- E. Comply with UL 1598 for fluorescent luminaires.
- F. Lamp Base: Comply with ANSI C81.61 or IEC 60061-1.
- G. Bulb Shape: Complying with ANSI C79.1.
- H. Internal Type Emergency Power Unit: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with driver.
 - 1. Emergency Connection: Operate one lamp(s) continuously at an output of 1400 lumens each upon loss of normal power. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
 - 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 - 3. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:
 - a. Ambient Temperature: Less than 0 deg F or exceeding 104 deg F, with an average value exceeding 95 deg F over a 24-hour period.
 - b. Ambient Storage Temperature: Not less than minus 4 deg F and not exceeding 140 deg F.
 - c. Humidity: More than 95 percent (condensing).
 - d. Altitude: Exceeding 3300 feet.
 - 4. Nightlight Connection: Operate lamp continuously at 40 percent of rated light output.
 - 5. Test Push-Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.
 - a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 - b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 - 6. Battery: Sealed, maintenance-free, nickel-cadmium type.
 - 7. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
 - 8. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.

9. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
- I. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more lamps, remote mounted from luminaire.
 1. Emergency Connection: Operate one LED lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire driver.
 2. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
 3. Nightlight Connection: Operate lamp in a remote luminaire continuously.
 4. Battery: Sealed, maintenance-free, nickel-cadmium type.
 5. Charger: Fully automatic, solid-state, constant-current type.
 6. Housing: NEMA 250, Type 1 enclosure listed for installation inside, on top of, or remote from luminaire. Remote assembly shall be located no less than half the distance recommended by the emergency power unit manufacturer, whichever is less.
 7. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
 8. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
 9. Remote Test: Switch in handheld remote device aimed in direction of tested unit initiates coded infrared signal. Signal reception by factory-installed infrared receiver in tested unit triggers simulation of loss of its normal power supply, providing visual confirmation of either proper or failed emergency response.
 10. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.3 EMERGENCY LIGHTING

- A. General Requirements for Emergency Lighting Units: Self-contained units.
- B. Emergency Luminaires:
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Amerlux.
 - b. Architectural Lighting Works.
 - c. Cooper Lighting, an Eaton business.
 - d. Dual-Lite.
 - e. GE Lighting Solutions.
 - f. Juno Lighting Group by Schneider Electric.

- g. Lightolier; a Philips group brand.
 - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - i. Philips Lighting Company.
- 2. Emergency Luminaires: as indicated on Interior Luminaire Schedule, with the following additional features:
 - a. Operating at nominal voltage of 120 V ac.
 - b. Internal emergency power unit.
 - c. Rated for installation in damp locations, and for sealed and gasketed luminaires in wet locations.
 - d. UL 94 5VA flame rating.

C. Emergency Lighting Unit:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Amerlux.
 - b. Architectural Lighting Works.
 - c. Cooper Lighting, an Eaton business.
 - d. Dual-Lite.
 - e. Evenlite, Inc.
 - f. GE Lighting Solutions.
 - g. Lighting Services, Inc.
 - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - i. Ruud Lighting Direct.
- 2. Emergency Lighting Unit: as indicated on Interior Luminaire Schedule.
- 3. Operating at nominal voltage of 120 V ac.
- 4. Wall with universal junction box adaptor.
- 5. UV stable thermoplastic housing, rated for damp locations.
- 6. Two LED lamp heads.
- 7. Internal emergency power unit.

2.4 EXIT SIGNS

- A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.
- B. Internally Lighted Signs:
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Amerlux.
 - b. Cooper Lighting, an Eaton business.
 - c. Evenlite, Inc.
 - d. Hubbell Industrial Lighting; Hubbell Incorporated.

- e. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - f. Philips Lighting Company.
 - g. Ruud Lighting Direct.
- 2. Operating at nominal voltage of 120 V ac.
 - 3. Lamps for AC Operation: LEDs; 50,000 hours minimum rated lamp life.
 - 4. Self-Powered Exit Signs (Battery Type): Internal emergency power unit.

2.5 MATERIALS

A. Metal Parts:

- 1. Free of burrs and sharp corners and edges.
- 2. Sheet metal components shall be steel unless otherwise indicated.
- 3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access:

- 1. Smooth operating, free of light leakage under operating conditions.
- 2. Designed to permit relamping without use of tools.
- 3. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

- 1. Tempered Fresnel glass.
- 2. Glass: Annealed crystal glass unless otherwise indicated.
- 3. Acrylic: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
- 4. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Housings:

- 1. Extruded aluminum housing and heat sink.
- 2. Clear powder coat and painted finish.

E. Conduit: Rigid galvanized steel, minimum 3/4 inch in diameter.

2.6 METAL FINISHES

- ### A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.7 LUMINAIRE SUPPORT COMPONENTS

- A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.
- B. Support Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for conditions affecting performance of luminaires.
- B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before luminaire installation.
- C. Examine walls, floors, roofs, and ceilings for suitable conditions where emergency lighting luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with NECA 1.
- B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.
- C. Install lamps in each luminaire.
- D. Supports:
 - 1. Sized and rated for luminaire and emergency power unit weight.
 - 2. Able to maintain luminaire position when testing emergency power unit.
 - 3. Provide support for luminaire and emergency power unit without causing deflection of ceiling or wall.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire and emergency power unit weight and vertical force of 400 percent of luminaire weight.
- E. Wall-Mounted Luminaire Support:
 - 1. Do not attach luminaires directly to gypsum board.
- F. Suspended Luminaire Support:
 - 1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.

2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling Grid Mounted Luminaires:

1. Secure to any required outlet box.
2. Secure emergency power unit using approved fasteners in a minimum of four locations, spaced near corners of emergency power unit.
3. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

3.3 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections:
1. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
- B. Luminaire will be considered defective if it does not pass operation tests and inspections.
- C. Prepare test and inspection reports.

3.5 STARTUP SERVICE

- A. Perform startup service:
1. Charge emergency power units and batteries minimum of one hour and depress switch to conduct short-duration test.
 2. Charge emergency power units and batteries minimum of 24 hours and conduct one-hour discharge test.

3.6 ADJUSTING

- A. Adjustments: Within 12 months of date of Substantial Completion, provide on-site visit to do the following:

1. Inspect all luminaires. Replace lamps, emergency power units, batteries, signs, or luminaires that are defective.
 - a. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
2. Conduct short-duration tests on all emergency lighting.

END OF SECTION 265213

SECTION 265619 – LED EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Exterior solid-state luminaires that are designed for and exclusively use LED lamp technology.
 - 2. Luminaire supports.
 - 3. Luminaire-mounted photoelectric relays.

- B. Related Requirements:

- 1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

- A. CCT: Correlated color temperature.
- B. CRI: Color rendering index.
- C. Fixture: See "Luminaire."
- D. IP: International Protection or Ingress Protection Rating.
- E. Lumen: Measured output of lamp and luminaire, or both.
- F. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of luminaire.
 - 1. Arrange in order of luminaire designation.
 - 2. Include data on features, accessories, and finishes.

3. Include physical description and dimensions of luminaire.
 4. Lamps, include life, output (lumens, CCT, and CRI), and energy-efficiency data.
 5. Photometric data and adjustment factors based on laboratory tests, complying with IES LM-80.
 - a. Manufacturer's Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the NVLAP for Energy Efficient Lighting Products.
 - b. Testing Agency Certified Data: For indicated luminaires, photometric data certified by a qualified independent testing agency. Photometric data for remaining luminaires shall be certified by manufacturer.
 6. Wiring diagrams for power, control, and signal wiring.
 7. Photoelectric relays.
 8. Means of attaching luminaires to supports and indication that the attachment is suitable for components involved.
- B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
 2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 3. Include diagrams for power, signal, and control wiring.
- C. Samples: For each luminaire and for each color and texture indicated with factory-applied finish.
- D. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.
- E. Delegated-Design Submittal: For luminaire supports.
1. Include design calculations for luminaire supports and seismic restraints.

1.5 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Luminaires.
 2. Structural members to which equipment and luminaires will be attached.
 3. Underground utilities and structures.
 4. Existing underground utilities and structures.
 5. Above-grade utilities and structures.
 6. Existing above-grade utilities and structures.
 7. Building features.
 8. Vertical and horizontal information.
- B. Qualification Data: For testing laboratory providing photometric data for luminaires.

- C. Seismic Qualification Data: For luminaires, accessories, and components, from manufacturer.
 - 1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - 2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - 3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
- D. Product Certificates: For each type of the following:
 - 1. Luminaire.
 - 2. Photoelectric relay.
- E. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.
- F. Source quality-control reports.
- G. Sample warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For luminaires and photoelectric relays to include in operation and maintenance manuals.
 - 1. Provide a list of all lamp types used on Project. Use ANSI and manufacturers' codes.
 - 2. Provide a list of all photoelectric relay types used on Project; use manufacturers' codes.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Lamps: Ten for every 100 of each type and rating installed. Furnish at least one of each type.
 - 2. Glass, Acrylic, and Plastic Lenses, Covers, and Other Optical Parts: One for every 100 of each type and rating installed. Furnish at least one of each type.
 - 3. Diffusers and Lenses: One for every 100of each type and rating installed. Furnish at least one of each type.
 - 4. Globes and Guards: One for every 20of each type and rating installed. Furnish at least one of each type.

1.8 QUALITY ASSURANCE

- A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturers' laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

- B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products and complying with applicable IES testing standards.
- C. Provide luminaires from a single manufacturer for each luminaire type.
- D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.
- E. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering prior to shipping.

1.10 FIELD CONDITIONS

- A. Verify existing and proposed utility structures prior to the start of work associated with luminaire installation.
- B. Mark locations of exterior luminaires for approval by Architect prior to the start of luminaire installation.

1.11 WARRANTY

- A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including luminaire support components.
 - b. Faulty operation of luminaires and accessories.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 - 2. Warranty Period: 2 year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Seismic Performance: Luminaires shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
- B. Seismic Performance: Luminaires and lamps shall be labeled vibration and shock resistant.
 - 1. The term "withstand" means "the luminaire will remain in place without separation of any parts when subjected to the seismic forces specified and the luminaire will be fully operational during and after the seismic event."

2.2 LUMINAIRE REQUIREMENTS

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in the CEC, by a qualified testing agency, and marked for intended location and application.
- B. NRTL Compliance: Luminaires shall be listed and labeled for indicated class and division of hazard by an NRTL.
- C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
- D. UL Compliance: Comply with UL 1598 and listed for wet location.
- E. Lamp base complying with ANSI C81.61 or IEC 60061-1.
- F. Bulb shape complying with ANSI C79.1.
- G. CRI of minimum 85. CCT of 3000 K.
- H. L70 lamp life of 50,000 hours.
- I. Lamps dimmable from 100 percent to 0 percent of maximum light output.
- J. Internal driver.
- K. Nominal Operating Voltage: 120 V ac.
- L. In-line Fusing: On the primary for each luminaire.
- M. Lamp Rating: Lamp marked for outdoor use and in enclosed locations.
- N. Source Limitations: Obtain luminaires from single source from a single manufacturer.

- O. Source Limitations: For luminaires, obtain each color, grade, finish, type, and variety of luminaire from single source with resources to provide products of consistent quality in appearance and physical properties.

2.3 LUMINAIRE-MOUNTED PHOTOELECTRIC RELAYS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
1. Atlas Lighting Products.
 2. Cooper Lighting, an Eaton business.
 3. Deco Lighting.
 4. Eaton.
 5. GE Lighting Solutions.
 6. Intelligent Illuminations, Inc.
 7. Intermatic, Inc.
 8. Lithonia Lighting; Acuity Brands Lighting, Inc.
 9. Philips Lighting Company.
 10. Schneider Electric USA, Inc.
 11. Siemens Industry, Inc., Building Technologies Division.
- B. Comply with UL 773 or UL 773A.
- C. Contact Relays: Factory mounted, single throw, designed to fail in the on position, and factory set to turn light unit on at 1.5 to 3 fc and off at 4.5 to 10 fc with 15-second minimum time delay. Relay shall have directional lens in front of photocell to prevent artificial light sources from causing false turnoff.
1. Relay with locking-type receptacle shall comply with ANSI C136.10.
 2. Adjustable window slide for adjusting on-off set points.

2.4 LUMINAIRE TYPES

- A. Area and Site:
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Area Lighting.
 - b. Atlas Lighting Products.
 - c. Cooper Lighting, an Eaton business.
 - d. Deco Lighting.
 - e. Gallium Lighting, LLC.
 - f. GE Lighting Solutions.
 - g. H.E. Williams.
 - h. Howard Lighting Products.
 - i. INITIAL-LED.

- j. Juno Lighting Group by Schneider Electric.
 - k. KIM Lighting.
 - l. Lightolier; a Philips group brand.
 - m. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - n. Luraline Lighting.
 - o. OSRAM SYLVANIA.
 - p. RAB Lighting.
 - q. Selux Corporation.
- 2. Luminaire Shape: Round or Square.
 - 3. Mounting: Pole or Building with extruded-aluminum rectangular or round arm, 13 inches in length.
 - 4. Distribution: Type III.
 - 5. Diffusers and Globes: Tempered Fresnel glass.
 - 6. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Clear powder-coat and painted finish.

B. Bollard:

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Architectural Area Lighting.
 - b. Cooper Lighting, an Eaton business.
 - c. GE Lighting Solutions.
 - d. H.E. Williams.
 - e. Howard Lighting Products.
 - f. KIM Lighting.
 - g. Lightolier; a Philips group brand.
 - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - i. Luraline Lighting.
 - j. Neenah Foundry Company.
 - k. OSRAM SYLVANIA.
 - l. RAB Lighting.
 - m. Selux Corporation.
- 2. Shape: Round or Square.
- 3. Height Above Finished Grade: 30 inches.
- 4. Overall Height: 30 inches.
- 5. Diameter: 6 inches.
- 6. Mounting: 3 point cast aluminum base.
- 7. Distribution: Type III.
- 8. Diffusers and Globes: Tempered Fresnel glass.
- 9. Housings:
 - a. Extruded-aluminum housing and heat sink.

- b. Clear powder-coat and painted finish.

C. Canopy:

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - a. Cooper Lighting, an Eaton business.
 - b. Gallium Lighting, LLC.
 - c. H.E. Williams.
 - d. Howard Lighting Products.
 - e. Juno Lighting Group by Schneider Electric.
 - f. KIM Lighting.
 - g. Lightolier; a Philips group brand.
 - h. Lithonia Lighting; Acuity Brands Lighting, Inc.
 - i. OSRAM SYLVANIA.
 - j. RAB Lighting.
 - k. Selux Corporation.
2. Shape: Round and Square.
3. Dimensions: 12 inches in diameter.
4. Diffusers and Globes: Tempered Fresnel glass.
5. Housings:
 - a. Extruded-aluminum housing and heat sink.
 - b. Clear anodized powder-coat and painted finish.

2.5 MATERIALS

- A. Metal Parts: Free of burrs and sharp corners and edges.
- B. Sheet Metal Components: Corrosion-resistant aluminum. Form and support to prevent warping and sagging.
- C. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses.
- D. Diffusers and Globes:
 1. Acrylic Diffusers: 100 percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
 2. Glass: Annealed crystal glass unless otherwise indicated.
 3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

- E. Lens and Refractor Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
- F. Reflecting surfaces shall have minimum reflectance as follows unless otherwise indicated:
 - 1. White Surfaces: 85 percent.
 - 2. Specular Surfaces: 83 percent.
 - 3. Diffusing Specular Surfaces: 75 percent.
- G. Housings:
 - 1. Rigidly formed, weather- and light-tight enclosure that will not warp, sag, or deform in use.
 - 2. Provide filter/breather for enclosed luminaires.
- H. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.
 - 1. Label shall include the following lamp characteristics:
 - a. "USE ONLY" and include specific lamp type.
 - b. Lamp diameter, shape, size, wattage and coating.
 - c. CCT and CRI for all luminaires.

2.6 FINISHES

- A. Variations in Finishes: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- B. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.
- C. Factory-Applied Finish for Aluminum Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
 - 1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
 - 2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20 requirements; and seal aluminum surfaces with clear, hard-coat wax.
 - 3. Class I, Clear-Anodic Finish: AA-M32C22A41 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 - 4. Class I, Color-Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: Medium satin; Chemical Finish: Etched, medium matte; Anodic Coating: Architectural Class I,

integrally colored or electrolytically deposited color coating 0.018 mm or thicker), complying with AAMA 611.

a. Color: Medium bronze.

D. Factory-Applied Finish for Steel Luminaires: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, to remove dirt, oil, grease, and other contaminants that could impair paint bond. Grind welds and polish surfaces to a smooth, even finish. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1 or SSPC-SP 8.
2. Exterior Surfaces: Manufacturer's standard finish consisting of one or more coats of primer and two finish coats of high-gloss, high-build polyurethane enamel.
 - a. Color: Match Architect's sample of manufacturer's standard color.

2.7 LUMINAIRE SUPPORT COMPONENTS

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Examine roughing-in for luminaire electrical conduit to verify actual locations of conduit connections before luminaire installation.
- C. Examine walls, roofs, and canopy ceilings and overhang ceilings for suitable conditions where luminaires will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

- A. If approved by the Architect, use selected permanent luminaires for temporary lighting. When construction is substantially complete, clean luminaires used for temporary lighting and install new lamps.

3.3 GENERAL INSTALLATION REQUIREMENTS

- A. Comply with NECA 1.
- B. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.
- C. Install lamps in each luminaire.
- D. Fasten luminaire to structural support.
- E. Supports:
 - 1. Sized and rated for luminaire weight.
 - 2. Able to maintain luminaire position after cleaning and relamping.
 - 3. Support luminaires without causing deflection of finished surface.
 - 4. Luminaire-mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and a vertical force of 400 percent of luminaire weight.
- F. Wall-Mounted Luminaire Support:
 - 1. Attached to a minimum 1/8 inch backing plate attached to wall structural members.
- G. Wiring Method: Install cables in raceways. Conceal raceways and cables.
- H. Install luminaires level, plumb, and square with finished grade unless otherwise indicated.
- I. Coordinate layout and installation of luminaires with other construction.
- J. Adjust luminaires that require field adjustment or aiming. Include adjustment of photoelectric device to prevent false operation of relay by artificial light sources, favoring a north orientation.
- K. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" and Section 260533 "Raceways and Boxes for Electrical Systems" for wiring connections and wiring methods.

3.4 BOLLARD LUMINAIRE INSTALLATION:

- A. Align units for optimum directional alignment of light distribution.
 - 1. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.5 INSTALLATION OF INDIVIDUAL GROUND-MOUNTED LUMINAIRES

- A. Aim as indicated on Drawings.

- B. Install on concrete base with top 4 inches above finished grade or surface at luminaire location. Cast conduit into base, and finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Section 033000 "Cast-in-Place Concrete."

3.6 CORROSION PREVENTION

- A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.
- B. Steel Conduits: Comply with Section 260533 "Raceways and Boxes for Electrical Systems." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.

3.7 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

- A. Inspect each installed luminaire for damage. Replace damaged luminaires and components.
- B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
 - 2. Verify operation of photoelectric controls.
- C. Illumination Tests:
 - 1. Measure light intensities at night. Use photometers with calibration referenced to NIST standards. Comply with the following IES testing guide(s):
 - a. IES LM-5.
 - b. IES LM-50.
 - c. IES LM-52.
 - d. IES LM-64.
 - e. IES LM-72.
 - f. IES LM-80
 - 2. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
- D. Luminaire will be considered defective if it does not pass tests and inspections.

- E. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.9 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Train Owner's maintenance personnel to adjust, operate, and maintain luminaires and photocell relays.

3.10 ADJUSTING

- A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.
 - 1. During adjustment visits, inspect all luminaires. Replace lamps or luminaires that are defective.
 - 2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
 - 3. Adjust the aim of luminaires in the presence of the Architect.

END OF SECTION 265619

SECTION 275126 – ASSISTIVE LISTENING SYSTEM

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. General Requirement
- B. System Description
- C. Acceptable Producers
- D. Transmitters
- E. Receivers
- F. Radio Frequencies
- G. Audio Frequencies
- H. Microphones
- I. Wiring
- J. Deliverables
- K. Adjustments
- L. Related Requirements:
 - 1. Section 260523 "Control-Voltage Electrical Power Cables" for control systems communications cables and Classes 1, 2 and 3 control cables.
 - 2. 2022 California Building Code section 11B-219 and 11B-706

1.3 DEFINITIONS

- A. DHCP: Dynamic Host Configuration Protocol.
- B. FXO: Foreign eXchange Office.
- C. H.323: Audio and Video Protocol.
- D. SIP: Session Initiation Protocol.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For educational intercommunications and program systems.

1. Include plans, elevations, sections, and mounting attachment details.
2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include scaled drawings for administrative console and speaker-microphone station arrangement of built-in equipment.
4. Include diagrams for power, signal, and control wiring.
 - a. Identify terminals to facilitate installation, operation, and maintenance.
 - b. Single-line diagram showing interconnection of components.
 - c. Cabling diagram showing cable routing.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:

1. Reflected ceiling plans, drawn to scale, on which ceiling-mounted items including luminaires, diffusers, grilles, speakers, sprinklers, access panels, and special moldings are shown and coordinated with each other, using input from installers of the items involved.
2. Elevation drawings, drawn to scale, on which wall-mounted items including luminaires, intercommunications components, windows, doors, access panels, wall finishes, trims, piping, and conduit are shown and coordinated with each other, using input from Installers of the items involved.

B. Qualification Data: For Installer and testing agency.

C. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For educational intercommunications and program systems to include in operation and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. A record of final matching transformer-tap settings and signal ground-resistance measurement certified by Installer.
2. A record of Owner's equipment-programming option decisions.
3. Plans, drawn to scale, indicating location, designation, and connection of intercommunications system components.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On USB media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.7 QUALITY ASSURANCE

- A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified agency, with the experience and capability to conduct testing indicated.
 - 1. Testing Agency's Field Supervisor: Certified by NICET as Audio Systems Level III Technician.
 - 2. Testing Agency's Field Supervisor:

1.8 COORDINATION

- A. Coordinate layout and installation of ceiling-mounted speaker microphones and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. **Manufacturers:** Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
 - 1. Lightspeed
 - a. Media connector / power supply
 - b. Redcat POD portable receiver (with speaker, microphone)
 - c. Redcat Active station with bluetooth & POD charging station.
 - 2. William Sound
 - 3. Listen Technologies

2.2 SYSTEM DESCRIPTION

- A. Each system shall include an FM transmitter with antenna(s) and two or more FM receivers, all operating in the 72 - 76 MH band. Both transmitters and receivers shall operate properly with FM receivers and transmitters, respectively, of other manufacturers listed below using the same frequency. These Standards require the provision of interoperable, industry standard type systems; proprietary systems are specifically not acceptable. Builder required submittals shall include a complete description of all incompatibilities.
- B. In areas with a sound reinforcement system, the assistive listening system shall retransmit the sound reinforcement system electrical output. In areas without a sound reinforcement system, the assistive listening system shall include a microphone system for voice input from live speakers.

- C. The quantity of receivers provided shall not be less than 4 of the maximum occupancy of the area or two (2) whichever is greater..
- D. Equipment: Modular type using solid-state components, fully rated for continuous duty unless otherwise indicated. Select equipment for normal operation on input power usually supplied at 110 to 130 V, 60 H \square in a satisfactory manner without the requirement of any external power conditioning equipment. Comply with UL 813.

2.3 TRANSMITTERS (Portable)

- A. Transmitters shall output frequency modulated RF in the 72-76 MH \square band with frequency stability and purity, deviation, power output and other characteristics as specified by the Federal Communications Commission (FCC) for unlicensed operation. Transmitter frequency deviation shall be 75 KH \square nominal. Each transmitter shall have a minimum of six fixed, switch selectable, output frequencies. Selection shall be by use of a tool such as a screwdriver or other means designed to discourage frequency changes by unauthorized persons. Specifically describe frequency changing means in submittal. Controls shall include On-Off switch and LED type Power On indicator. Transmitter shall be suitable for continuous operation on 120 VAC 60 H \square building power. Williams T-17 is acceptable.
- B. Provide sufficient detail in the Contract Documents for proper installation of the transmitter, or require the Builder to submit sketches showing the proposed installation location and details. The Builder's proposal shall show permanent installation in a secure location and shall be approved by the University before proceeding.
- C. If the area of assembly has a sound reinforcement system, either existing or provided in the project, the transmitter shall be installed in the sound reinforcement system rack, if possible, or securely installed nearby. The Contract Documents shall not allow installation of the transmitter without providing fasteners securing it to the mounting surface, unless a specific reason not to provide fasteners is given by the Contract Documents.

2.4 RECEIVERS (Portable)

- A. Pocket si \square rechargeable battery operated FM receiver with 1/8" or 3.5 mm earphone jack, ear bud type earphone, battery and charger. Antenna shall be internal to case or integral to the earphone cord. Separate or external antennas are not permitted. Dimensions shall not exceed 1" X 3" X 4"; weight with battery shall not exceed 4 ounces. Minimum audio output 50 mW with total harmonic distortion not exceeding 2.1 producing average SSPL90 of 135 dB or more from the earphone. Controls shall include On-Off, Volume, Channel and LED type Power On indicator. Provide automatic squelch, either manually adjustable or fixed at 10 microvolts RF input nominal. Williams PPA R7-6NA is acceptable.
- B. Hearing Aide compatibility; receivers shall interface with hearing aid telecoils through the provision of neckloops.

- C. Receivers shall be capable of providing a sound pressure of 110dB minimum and 118 dB maximum with a dynamic range on the volume control of 50dB.
- D. The signal-to-noise ration for internally generated noise in ALS shall be 18dB minimum.
- E. The peak clipping shall not exceed 18dB of clipping relative to the peaks of speech.
- F. Speakers: Free of noise and distortion during operation and when in standby mode.

2.5 RADIO FREQUENCIES

- A. The primary radio frequency in use at the University is 72.9 MH \square All systems shall operate at this frequency unless written permission is granted by the University to operate at one of the alternate frequencies of 72.1, 72.5, 74.7, 75.3 or 75.7 MH \square All receivers and transmitters shall be capable of operating on all of these frequencies with switch selection of the active frequency. Continuous tuning is not acceptable.

2.6 AUDIO FREQUENCIES

- A. System +/- 3 dB audio bandwidth, from microphone or transmitter input to earphone output, shall be 200 H \square - 8 KH \square minimum.

2.7 MICROPHONES (portable – Pendant)

- A. Where a microphone system is required, provide lavalier type with cable length sufficient to reach transmitter. If the assembly area is provided with a podium, provide a microphone on the podium with a cable and plug connecting it to a flush floor jack. The floor jack shall be cable connected to the transmitter input. Microphones shall be Shure, Dukane, or other if normally provided by ALS manufacturer with ALS transmitter proposed. Floor jacks shall be locking XLR type with stainless steel trim.

2.8 INTERCOMMUNICATION AMPLIFIER

- A. Minimum Output Power: 15 W; adequate for all functions.
- B. Total Harmonic Distortion: Less than 5 percent at rated output power with load equivalent to one station connected to output terminals.
- C. Minimum Signal-to-Noise Ratio: 50 dB, at rated output.
- D. Frequency Response: Within plus or minus 3 dB from 70 to 10,000 H \square
- E. Output Regulation: Maintains output level within 2 dB from full to no load.

- F. Input Sensitivity: Matched to input circuit and to provide full-rated output with sound-pressure level of less than 10 dynes/sq. cm impinging on microphones in administrative console, speaker microphones, or handset transmitters.
- G. Amplifier Protection: Prevents damage from shorted or open output.

PART 3 - EXECUTION

3.1 OWNER PROVIDE EQUIPMENT

- A. For ALS to be used by visitors in classroom in each at each school site, at a minimum of two (2) sets of portable ALS, each with a transmitter and at least two (2) hearing-aid compatible receivers, shall be provided. The portable ALS receivers and transmitters shall be stored in administration office until requested.
- B. Each portable ALS system shall include the following components:
 - 1. One (1) portable transmitter.
 - 2. Four (4) portable receiver units
 - 3. One (1) battery Charger.
 - 4. Four (4) NiMH Rechargeable batteries.
 - 5. One (1) Lavalier Microphone.
 - 6. One (1) Omni conferencing microphone
 - 7. One (1) line/mic 'Y' cable.
 - 8. One (1) Induction Neck Loop type receiver.

3.2 SYSTEM PROGRAMMING

- A. Programming: Fully brief Owner on available programming options. Record Owner's decisions and set up initial system program. Prepare a written record of decisions, implementation methodology, and final results.

3.3 FIELD QUALITY CONTROL

- A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- B. Perform tests and inspections with the assistance of a factory-authorized service representative:
- C. Tests and Inspections:
 - 1. Schedule tests with at least seven days' advance notice of test performance.
 - 2. After installing educational intercommunications and program systems and after electrical circuitry has been energized, test for compliance with requirements.

3. Operational Test: Test originating station-to-station messages at each intercommunication station. Verify proper routing and volume levels and that system is free of noise and distortion. Test each available message path from each station on system.
 4. Frequency Response Test: Determine frequency response of two transmission paths by transmitting and recording audio tones. Minimum acceptable performance is within 3 dB from 150 to 2500 Hz.
 5. Signal-to-Noise Ratio Test: Measure signal-to-noise ratio of complete system at normal gain settings as follows:
 - a. Disconnect speaker microphone and replace it in the circuit with a signal generator using a 1000-Hz signal. Measure signal-to-noise ratio at speakers.
 - b. Repeat test for three speaker microphones, one administrative console microphone.
 - c. Minimum acceptable ratio is 45 dB.
 6. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 150, 200, 400, 1000, and 2500 Hz into each intercom. For each frequency, measure distortion in the paging and all-call amplifier outputs. Maximum acceptable distortion at any frequency is 5 percent total harmonics.
 7. Acoustic Coverage Test: Feed pink noise into system using octaves centered at 500 and 4000 Hz. Use sound-level meter with octave-band filters to measure level at five locations in each paging zone. Maximum permissible variation in level is plus or minus 3 dB; in levels between adjacent zones, plus or minus 5 dB.
 8. Power Output Test: Measure electrical power output of each paging amplifier at normal gain settings of 150, 1000, and 2500 Hz. Maximum variation in power output at these frequencies is plus or minus 3 dB.
 9. Signal Ground Test: Measure and report ground resistance at system signal ground. Comply with testing requirements in Section 270526 "Grounding and Bonding for Communications Systems."
- D. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified. Prepare a list of final tap settings of paging and independent room speaker-line matching transformers.
- E. Educational intercommunications and program systems will be considered defective if they do not pass tests and inspections.
- F. Prepare test and inspection reports.
- 3.4 STARTUP SERVICE
- A. Engage a factory-authorized service representative to perform startup service and initial system programming.
1. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements.
 2. Complete installation and startup checks according to manufacturer's written instructions.

3.5 ADJUSTING

- A. On-Site Assistance: Engage a factory-authorized service representative to provide on-site assistance in adjusting sound levels, resetting transformer taps, and adjusting controls to meet occupancy conditions.
- B. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the educational intercommunications and program systems.
 - 1. Train Owner's maintenance personnel on programming equipment for starting up and shutting down, troubleshooting, servicing, and maintaining the system and equipment.

END OF SECTION 275126

SECTION 284621.11 - ADDRESSABLE FIRE-ALARM SYSTEMS

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. Existing fire-alarm system to be modified.
2. Addressable fire-alarm system.
3. Fire-alarm control unit (FACU).
4. Manual fire-alarm boxes.
5. System smoke detectors.
6. Duct smoke detectors.
7. Heat detectors.
8. Fire-alarm notification appliances.
9. Fire-alarm graphic annunciators.
10. Fire-alarm remote annunciators.
11. Fire-alarm addressable interface devices.
12. Digital alarm communicator transmitters (DACTs).

- B. Related Requirements:

1. Section 260519 "Low-Voltage Electrical Power Conductors and Cables" or Section 260523 "Control Voltage Electrical Power Cables" for cables and conductors for fire-alarm systems.

1.3 DEFINITIONS

- A. DACT: Digital alarm communicator transmitter.
- B. EMT: Electrical metallic tubing.
- C. FACU: Fire-alarm control unit.
- D. High-Performance Building: A building that integrates and optimizes on a life-cycle basis all major high-performance attributes, including energy conservation, environment, safety, security, durability, accessibility, cost-benefit, productivity, sustainability, functionality, and operational considerations.

- E. Mode: The terms "Active Mode," "Off Mode," and "Standby Mode" are used as defined in the 2007 Energy Independence and Security Act (EISA).
- F. NICET: National Institute for Certification in Engineering Technologies.
- G. PC: Personal computer.
- H. Voltage Class: For specified circuits and equipment, voltage classes are defined as follows:
 - 1. Control Voltage: Listed and labeled for use in remote-control, signaling, and power-limited circuits supplied by a Class 2 or Class 3 power supply having rated output not greater than 150 V and 5 A, allowing use of alternate wiring methods complying with NFPA 70, Article 725.
 - 2. Low Voltage: Listed and labeled for use in circuits supplied by a Class 1 or other power supply having rated output not greater than 1000 V, requiring use of wiring methods complying with NFPA 70, Article 300, Part I.

1.4 SEQUENCING AND SCHEDULING

- A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. When new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service, and label existing fire-alarm equipment "NOT IN SERVICE" until removed from building.

1.5 ACTION SUBMITTALS

- A. Approved Permit Submittal: Submittals must be approved by authorities having jurisdiction prior to submitting them to Architect.
- B. Product Data: For each type of product, including furnished options and accessories.
 - 1. Include construction details, material descriptions, dimensions, profiles, and finishes.
 - 2. Include rated capacities, operating characteristics, and electrical characteristics.
- C. Shop Drawings: For fire-alarm system.
 - 1. Comply with recommendations and requirements in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - 2. Include plans, elevations, sections, and details, including details of attachments to other Work.
 - 3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.
 - 4. Graphic Annunciator panel details as required by authorities having jurisdiction.
 - 5. Detail assembly and support requirements.
 - 6. Include voltage drop calculations for notification-appliance circuits.

7. Include battery-size calculations.
 8. Include input/output matrix.
 9. Include written statement from manufacturer that equipment and components have been tested as a system and comply with requirements in this Section and in NFPA 72.
 10. Include performance parameters and installation details for each detector.
 11. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
 12. Provide program report showing that air-sampling detector pipe layout balances pneumatically within airflow range of air-sampling detector.
 13. Provide control wiring diagrams for fire-alarm interface to HVAC; coordinate location of duct smoke detectors and access to them.
 - a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
 - b. Show field wiring and equipment required for HVAC unit shutdown on alarm.
 - c. Locate detectors in accordance with manufacturer's written instructions.
 14. Include floor plans to indicate final device locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.
- D. Delegated Design Submittal: For notification appliances and smoke and heat detectors, in addition to submittals listed above, indicate compliance with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.
1. Drawings showing location of each notification appliance and smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of device.
 2. Design Calculations: Calculate requirements for selecting spacing and sensitivity of detection, complying with NFPA 72. Calculate spacing and intensities for strobe signals and sound-pressure levels for audible appliances.
 3. Indicate audible appliances required to produce square wave signal per NFPA 72.

1.6 INFORMATIONAL SUBMITTALS

A. Certificates:

1. Seismic Performance Certificates: For FACU, accessories, and components, from manufacturer. Include the following information:
 - a. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
 - b. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
 - c. Detailed description of equipment anchorage devices on which certification is based and their installation requirements.

B. Field quality-control reports.

- C. Qualification Statements: For Installer.
- D. Sample Warranty: Submittal must include line-item pricing for replacement parts and labor.

1.7 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following and deliver copies to Architect of Record, Project Inspector/authorities having jurisdiction, local fire authority, and Owner:
 - a. Comply with "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 - b. Provide "Fire-Alarm and Emergency Communications System Record of Completion Documents" in accordance with "Completion Documents" Article in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - c. Complete wiring diagrams showing connections between devices and equipment. Each conductor must be numbered at every junction point with indication of origination and termination points.
 - d. Riser diagram.
 - e. Device addresses.
 - f. Record copy of site-specific software.
 - g. Provide "Inspection and Testing Form" in accordance with "Inspection, Testing and Maintenance" chapter in NFPA 72, and include the following:
 - 1) Equipment tested.
 - 2) Frequency of testing of installed components.
 - 3) Frequency of inspection of installed components.
 - 4) Requirements and recommendations related to results of maintenance.
 - 5) Manufacturer's user training manuals.
 - h. Manufacturer's required maintenance related to system warranty requirements.
 - i. Abbreviated operating instructions for mounting at FACU and each annunciator unit.
- B. Software and Firmware Operational Documentation:
 - 1. Software operating and upgrade manuals.
 - 2. Program Software Backup: On USB media and approved online or cloud solution.
 - 3. Device address list.
 - 4. Printout of software application and graphic screens.

1.8 MAINTENANCE MATERIAL SUBMITTALS

- A. Extra Stock Material: Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Lamps for Remote Indicating Lamp Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 2. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but no fewer than one unit.
 3. Smoke Detectors, Fire Detectors: Quantity equal to 10 percent of amount of each type installed, but no fewer than one unit of each type.
 4. Detector Bases: Quantity equal to two percent of amount of each type installed, but no fewer than one unit of each type.
 5. Keys and Tools: One extra set for access to locked or tamperproofed components.
 6. Audible and Visual Notification Appliances: One of each type installed.
 7. Fuses: Two of each type installed in system. Provide in box or cabinet with compartments marked with fuse types and sizes.

1.9 QUALITY ASSURANCE

- A. Installer Qualifications:
1. Personnel must be trained and certified by manufacturer for installation of units required for this Project.
 2. Installation must be by personnel certified by NICET as fire-alarm Level III technician.
 3. Obtain certification by NRTL in accordance with NFPA 72.
 4. Licensed or certified by authorities having jurisdiction.

1.10 FIELD CONDITIONS

- A. Seismic Conditions: Unless otherwise indicated on Contract Documents, specified Work in this Section must withstand the seismic hazard design loads determined in accordance with ASCE/SEI 7 for installed elevation above or below grade.
1. The term "withstand" means "unit must remain in place without separation of parts from unit when subjected to specified seismic design loads and unit must be fully operational after seismic event."

1.11 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace fire-alarm system equipment and components that fail because of defects in materials or workmanship within specified warranty period.
1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 EXISTING FIRE-ALARM SYSTEM TO BE MODIFIED

- A. Basis for Pricing: Honeywell/Gamewell E3 Series.
- B. Description: Fully Automatic addressable system.
- C. Source Limitations for Fire-Alarm System and Components: Components must be compatible with, and operate as extension of, existing system. Provide system manufacturer's certification that components provided have been tested as, and will operate as, a system.

2.2 ADDRESSABLE FIRE-ALARM SYSTEM

- A. Description:
 - 1. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn-and-strobe notification for evacuation.
- B. Performance Criteria:
 - 1. Regulatory Requirements:
 - a. Fire-Alarm Components, Devices, and Accessories: Listed and labeled by a NRTL in accordance with NFPA 70 for use with selected fire-alarm system and marked for intended location and application.
 - 2. General Characteristics:
 - a. Automatic sensitivity control of certain smoke detectors.
 - 1) Manual stations.
 - 2) Heat detectors.
 - 3) Smoke detectors.
 - 4) Duct smoke detectors.
 - 5) Carbon monoxide detectors.
 - 6) Automatic sprinkler system water flow.
 - b. Fire-alarm signal must initiate the following actions:
 - 1) Continuously operate alarm notification appliances.
 - 2) Identify alarm and specific initiating device at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
 - 3) Transmit alarm signal to remote alarm receiving station.
 - 4) Release fire and smoke doors held open by magnetic door holders.
 - 5) Switch HVAC equipment controls to shut down.

- 6) Record events in system memory.
 - 7) Record events by system printer.
 - 8) Indicate device in alarm on graphic annunciator.
- c. Supervisory signal initiation must be by one or more of the following devices and actions:
- 1) Valve supervisory switch.
 - 2) FACU has lost communication with network.
- d. System trouble signal initiation must be by one or more of the following devices and actions:
- 1) Open circuits, shorts, and grounds in designated circuits.
 - 2) Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
 - 3) Loss of communication with addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
 - 4) Loss of primary power at FACU.
 - 5) Ground or single break in internal circuits of FACU.
 - 6) Abnormal ac voltage at FACU.
 - 7) Break in standby battery circuitry.
 - 8) Failure of battery charging.
 - 9) Abnormal position of switch at FACU or annunciator.
- e. System Supervisory Signal Actions:
- 1) Initiate notification appliances.
 - 2) Identify specific device initiating event at FACU, connected network control panels, off-premises network control panels, and remote annunciators.
 - 3) Record event on system printer.
 - 4) After time delay of 200 seconds, transmit trouble or supervisory signal to remote alarm receiving station.
 - 5) Transmit system status to building management system.
 - 6) Display system status on graphic annunciator.
- f. Network Communications:
- 1) Provide network communications for fire-alarm system in accordance with fire-alarm manufacturer's written instructions.
 - 2) Provide network communications pathway per manufacturer's written instructions and requirements in NFPA 72 and NFPA 70.
- g. System Printer:
- 1) Printer must be listed and labeled as integral part of fire-alarm system.
- h. Device Guards:

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

i. Document Storage Box:

- 1) Description: Enclosure to accommodate standard 8-1/2-by-11 inch manuals and loose document records. Legend sheet will be permanently attached to door for system required documentation, key contacts, and system information. Provide two key ring holders with location to mount standard business cards for key contact personnel.
- 2) Material and Finish: 18-gauge cold-rolled steel; four mounting holes.
- 3) Color: Red powder-coat epoxy finish.
- 4) Labeling: Permanently screened with 1 inch high lettering "SYSTEM RECORD DOCUMENTS" with white indelible ink.
- 5) Security: Locked with 3/4 inch barrel lock. Provide solid 12 inch stainless steel piano hinge.

2.3 FIRE-ALARM CONTROL UNIT (FACU)

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 1. Honeywell/Gamewell E3 Series
- B. Description: Field-programmable, microprocessor-based, modular, power-limited design with electronic modules.
- C. Performance Criteria:
 1. Regulatory Requirements: Comply with 2022 CBC/CFC and 2022 NFPA 72 and UL 864.
 2. General Characteristics:
 - a. System software and programs must be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining information through failure of primary and secondary power supplies.
 - b. Include real-time clock for time annotation of events on event recorder and printer.
 - c. Provide communication between FACU and remote circuit interface panels, annunciators, and displays.
 - d. FACU must be listed for connection to central-station signaling system service.
 - e. Provide nonvolatile memory for system database, logic, and operating system and event history. System must require no manual input to initialize in the event of complete power down condition. FACU must provide minimum 500-event history log.

- f. Addressable Initiation Device Circuits: FACU must indicate which communication ☐ones have been silenced and must provide selective silencing of alarm notification appliance by building communication ☐one.
 - 1) Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: FACU must be listed for releasing service.
- g. Fire-Alarm Annunciator: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands.
- h. Alphanumeric Display and System Controls: Arranged for interface between human operator at FACU and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and programming and control menu.
 - 1) Annunciator and Display: LCD, three line(s) of 80 characters, minimum.
 - 2) Keypad: Arranged to permit entry and execution of programming, display, and control commands and to indicate control commands to be entered into system for control of smoke-detector sensitivity and other parameters.
- i. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:
 - 1) Pathway Class Designations: NFPA 72, Class B.
 - 2) Pathway Survivability: Level 1.
 - 3) Install no more than 256 addressable devices on each signaling-line circuit.
 - 4) Install fault circuit isolators to comply with circuit performance requirements of NFPA 72 or with manufacturer's written instructions, whichever is more conservative.
- j. Serial Interfaces:
 - 1) One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
 - 2) One RS 232 port for PC configuration.
- k. Smoke-Alarm Verification:
 - 1) Initiate audible and visible indication of "alarm-verification" signal at FACU.
 - 2) Activate approved "alarm-verification" sequence at FACU and detector.
 - 3) Record events by system printer.
 - 4) Sound general alarm if alarm is verified.
 - 5) Cancel FACU indication and system reset if alarm is not verified.

- l. Notification-Appliance Circuit:
 - 1) Audible appliances must sound in three-pulse temporal pattern, as defined in NFPA 72.
 - 2) Where notification appliances provide signals to sleeping areas, alarm signal must be 520 Hz square wave with intensity 15 dB above average ambient sound level or 5 dB above maximum sound level, or at least 75 dB(A-weighted), whichever is greater, measured at pillow.
 - 3) Visual alarm appliances must flash in synchronization where multiple appliances are in same field of view, as defined in NFPA 72.
- m. Remote Smoke-Detector Sensitivity Adjustment: Controls must select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and change those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory and print out final adjusted values on system printer.
- n. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to remote alarm station.
- o. Indicate number of alarm channels for automatic, simultaneous transmission of different announcements to different tones or for manual transmission of announcements by use of central-control microphone. Amplifiers must comply with UL 1711.
 - 1) Allow application of, and evacuation signal to, indicated number of tones and simultaneously allow voice paging to other tones selectively or in combination.
 - 2) Programmable tone and message sequence selection.
 - 3) Standard digitally recorded messages for "Evacuation" and "All Clear."
 - 4) Generate tones to be sequenced with audio messages of type recommended by NFPA 72 and that are compatible with tone patterns of notification-appliance circuits of FACU.
- p. Status Annunciator: Indicate status of various voice/alarm speaker tones and status of firefighters' two-way telephone communication tones.
- q. Preamplifiers, amplifiers, and tone generators must automatically transfer to backup units, on primary equipment failure.
- r. Printout of Events: On receipt of signal, print alarm, supervisory, and trouble events. Identify tone, device, and function. Include type of signal (alarm, supervisory, or trouble) and date and time of occurrence. Differentiate alarm signals from other printed indications. Also, print system reset event, including same information for device, location, date, and time. Commands initiate printing of list of existing alarm, supervisory, and trouble conditions in system and historical log of events.
- s. Primary Power: 24 V(dc) obtained from 120 V(ac) service and power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, and supervisory signals supervisory and DACT must be powered by 24 V(dc) source.

- t. Alarm current draw of entire fire-alarm system must not exceed 80 percent of power-supply module rating.
- u. Secondary Power: 24 V(dc) supply system with batteries, automatic battery charger, and automatic transfer switch.
- v. Batteries: Sealed lead calcium.

D. Accessories:

- 1. Instructions: Computer printout or typewritten instruction card mounted behind plastic or glass cover in stainless steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe functional operation of system under normal, alarm, and trouble conditions.

2.4 MANUAL FIRE-ALARM BOXES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1. Gamewell-FCI; Honeywell International, Inc.

- B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes must be finished in red with molded, raised-letter operating instructions in contrasting color; must show visible indication of operation; and must be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

- 1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
- 2. Double-action mechanism requiring two actions to initiate alarm, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to FACU.
- 3. Station Reset: Key- or wrench-operated switch.
- 4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm. Lifting cover actuates integral battery-powered audible horn intended to discourage false-alarm operation.
- 5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at top to permit lifting for access to initiate alarm.
- 6. Able to perform at up to 90 percent relative humidity at 90 deg F.
- 7. Material: Manual stations made of Lexan polycarbonate.
- 8. Able to be used in indoor areas.

2.5 SYSTEM SMOKE DETECTORS

- A. Photoelectric Smoke Detectors:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gamewell-FCI; Honeywell International, Inc.

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Detectors must be two-wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Multiple levels of detection sensitivity for each sensor.
- 13) Sensitivity levels based on time of day.

B. Ionization Smoke Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gamewell-FCI; Honeywell International, Inc.

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 268.

b. General Characteristics:

- 1) Detectors must be two-wire type.
- 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- 3) Base Mounting: Detector and associated electronic components must be mounted in twist-lock module that connects to fixed base. Provide terminals in fixed base for connection to building wiring.
- 4) Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- 5) Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- 6) Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- 7) Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - a) Primary status.
 - b) Device type.
 - c) Present average value.
 - d) Present sensitivity selected.
 - e) Sensor range (normal, dirty, etc.).
- 8) Detector must have functional humidity range within 10 to 90 percent relative humidity.
- 9) Color: White.
- 10) Remote Control: Unless otherwise indicated, detectors must be digital-addressable type, individually monitored at FACU for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by FACU.
- 11) Rate-of-rise temperature characteristic of combination smoke- and heat-detection units must be selectable at FACU for 15 or 20 deg F per minute.
- 12) Multiple levels of detection sensitivity for each sensor.
- 13) Sensitivity levels based on time of day.

2.6 DUCT SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Gamewell-FCI; Honeywell International, Inc.

B. Description: Photoelectric-type, duct-mounted smoke detector.

C. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.
- b. UL 268A.

2. General Characteristics:

- a. Detectors must be two-wire type.
- b. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.
- c. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
- d. Integral Visual-Indicating Light: LED type, indicating detector has operated and power-on status.
- e. Detector address must be accessible from FACU and must be able to identify detector's location within system and its sensitivity setting.
- f. Operator at FACU, having designated access level, must be able to manually access the following for each detector:
 - 1) Primary status.
 - 2) Device type.
 - 3) Present average value.
 - 4) Present sensitivity selected.
 - 5) Sensor range (normal, dirty, etc.).
- g. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with supplied detector for smoke detection in HVAC system ducts.
- h. Each sensor must have multiple levels of detection sensitivity.
- i. Relay Fan Shutdown: Fully programmable relay rated to interrupt fan motor-control circuit.

2.7 HEAT DETECTORS

A. Combination-Type Heat Detectors:

- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Gamewell-FCI; Honeywell International, Inc.
- 2. Performance Criteria:
 - a. Regulatory Requirements:
 - 1) NFPA 72.

2) UL 521.

b. General Characteristics:

1) Temperature sensors must test for and communicate sensitivity range of device.

c. Actuated by fixed temperature of 135 deg F Insert temperature or rate of rise that exceeds 15 deg F Insert temperature per minute unless otherwise indicated.

d. Mounting: Adapter plate for outlet box mounting Twist-lock base interchangeable with smoke-detector bases.

e. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

f. Detector must have functional humidity range of 10 to 90 percent relative humidity.

g. Color: White.

B. Fixed-Temperature-Type Heat Detectors:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gamewell-FCI; Honeywell International, Inc.

2. Performance Criteria:

a. Regulatory Requirements:

1) NFPA 72.

2) UL 521.

b. General Characteristics:

1) Actuated by temperature that exceeds fixed temperature of 190 deg F.

2) Mounting: Adapter plate for outlet box mounting.

3) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to FACU.

4) Detector must have functional humidity range of 10 to 90 percent.

5) Color: White.

2.8 FIRE-ALARM NOTIFICATION APPLIANCES

A. Fire-Alarm Audible Notification Appliances:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Gamewell-FCI; Honeywell International, Inc.

b. Silent Knight.

- c. [Gentex Corporation.](#)
 - d. Honeywell.
 - e. [Notifier; Honeywell International, Inc.](#)
 - f. [Wheelock, Life Safety and Mass Notification; Eaton, Electrical Sector.](#)
2. Description: Horns, bells, or other notification devices that cannot output voice messages.
3. Performance Criteria:
- a. Regulatory Requirements:
 - 1) NFPA 72.
 - b. General Characteristics:
 - 1) Individually addressed, connected to signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
 - 2) Connected to notification-appliance signal circuits, ☐oned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
 - 3) Chimes, Low-Level Output: Vibrating type, 75 dB(A-weighted) minimum rated output.
 - 4) Chimes, High-Level Output: Vibrating type, 81 dB(A-weighted) minimum rated output.
 - 5) Sounders, High Volume 24 V(dc): Less than 6 mA of alarm current.
 - 6) Sounders, Low Volume 24 V(dc): Less than 4 mA of alarm current.
 - 7) Audible notification appliances must have functional humidity range of 10 to 95 percent relative humidity.
 - 8) ISO Temporal 3 Evacuation Tone: 90 plus or minus 4 dB(A-weighted) at 24 V.
 - 9) ISO Temporal 3 Alert Tone: 95 plus or minus 5 dB(A-weighted) at 24 V.
 - 10) AS2220 Evacuation Tone: 93 plus or minus 4 dB(A-weighted) at 24 V.
 - 11) AS2220 Alert Tone: 93 plus or minus 5 dB(A-weighted) at 24 V.
 - 12) Horns: Electric-vibrating-polarized type, 24 V(dc); with provision for housing operating mechanism behind grille. Comply with UL 464. Horns must produce sound-pressure level of 90 dB(A-weighted), measured 10 ft. from horn, using coded signal prescribed in UL 464 test protocol.
 - 13) Combination Devices: Factory-integrated audible and visible devices in single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

B. Fire-Alarm Visible Notification Appliances:

- 1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. Gamewell-FCI; Honeywell International, Inc.
 - b. Silent Knight.
 - c. [Gentex Corporation.](#)
 - d. Honeywell.

- e. [Notifier; Honeywell International, Inc.](#)
- f. [Wheelock, Life Safety and Mass Notification; Eaton, Electrical Sector.](#)

2. Performance Criteria:

a. Regulatory Requirements:

- 1) NFPA 72.
- 2) UL 1971.

b. General Characteristics:

- 1) Rated Light Output:
 - a) 15/30/75/110 cd, selectable in field.
- 2) Clear or nominal white polycarbonate lens mounted on aluminum faceplate.
- 3) Mounting: Wall mounted unless otherwise indicated.
- 4) For units with guards to prevent physical damage, light output ratings must be determined with guards in place.
- 5) Flashing must be in temporal pattern, synchronized with other units.
- 6) Strobe Leads: Factory connected to screw terminals.
- 7) Mounting Faceplate: Factory finished, white.

2.9 FIRE-ALARM GRAPHIC ANNUNCIATORS

A. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:

- a. Gamewell-FCI; Honeywell International, Inc.
- b. Silent Knight.
- c. [Gentex Corporation.](#)
- d. Honeywell.
- e. [Notifier; Honeywell International, Inc.](#)
- f. [Wheelock, Life Safety and Mass Notification; Eaton, Electrical Sector.](#)

B. Performance Criteria:

1. Regulatory Requirements:

- a. NFPA 72.

2. General Characteristics:

- a. Graphic Annunciator Panel: Mounted in aluminum frame with nonglare, minimum 3/16 inch thick, clear acrylic cover over graphic representation of facility. Detector locations must be represented by red LED lamps. Normal system operation must be indicated by lighted, green LED. Trouble and supervisory alarms must be represented by amber LED.

- 1) Comply with UL 864.
- 2) Operating voltage must be 24 V(dc) provided by local 24 V power supply provided with annunciator.
- 3) Include built-in voltage regulation, reverse polarity protection, RS 232/422 serial communications, and lamp test switch.
- 4) Semiflush mounted in NEMA 250, Type 1 cabinet, with key lock and no exposed screws or hinges.
- 5) Graphic representation of facility must be CAD drawing and each detector must be represented by LED in its actual location. CAD drawing must be at 1:96 scale or larger.
- 6) LED representing detector must flash two times per second while detector is in alarm.

2.10 FIRE-ALARM REMOTE ANNUNCIATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
- a. Gamewell-FCI; Honeywell International, Inc.
 - b. Silent Knight.
 - c. Gentex Corporation.
 - d. Honeywell.
 - e. Notifier; Honeywell International, Inc.
 - f. Wheelock, Life Safety and Mass Notification; Eaton, Electrical Sector.
- B. Performance Criteria:
1. Regulatory Requirements:
 - a. NFPA 72.
 2. General Characteristics:
 - a. Annunciator functions must match those of FACU for alarm, supervisory, and trouble indications. Manual switching functions must match those of FACU, including acknowledging, silencing, resetting, and testing.
 - 1) Mounting: Surface cabinet, NEMA 250, Type 1.
 - b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights must match those of FACU. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.

2.11 FIRE-ALARM ADDRESSABLE INTERFACE DEVICES

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Silent Knight.
2. Honeywell (Notifier).
3. Honeywell.
4. Gamewell-FCI; Honeywell International, Inc.

B. Performance Criteria:

1. Regulatory Requirements:
 - a. NFPA 72.
2. General Characteristics:
 - a. Include address-setting means on module.
 - b. Store internal identifying code for control panel use to identify module type.
 - c. Listed for controlling HVAC fan motor controllers.
 - d. Monitor Module: Microelectronic module providing system address for alarm-initiating devices for wired applications with normally open contacts.
 - e. Control Module:
 - 1) Operate notification devices.
 - 2) Operate solenoids for use in sprinkler service.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTERS (DACTs)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:
- a. Gamewell-FCI; Honeywell International, Inc.
 - b. Silent Knight.
 - c. Gentex Corporation.
 - d. Honeywell.
 - e. Notifier; Honeywell International, Inc.
 - f. Wheelock, Life Safety and Mass Notification; Eaton, Electrical Sector.

B. Performance Criteria:

1. Regulatory Requirements:
 - a. NFPA 72.
2. General Characteristics:
 - a. DACT must be acceptable to remote central station and must be listed for fire-alarm use.
 - b. Functional Performance: Unit must receive alarm, supervisory, or trouble signal from FACU and automatically capture one two telephone line(s) and dial preset

number for remote central station. When contact is made with central station(s), signals must be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter must initiate local trouble signal and transmit signal indicating loss of telephone line to remote alarm receiving station over remaining line. Transmitter must automatically report telephone service restoration to central station. If service is lost on both telephone lines, transmitter must initiate local trouble signal.

- c. Local functions and display at DACT must include the following:
 - 1) Verification that both telephone lines are available.
 - 2) Programming device.
 - 3) LED display.
 - 4) Manual test report function and manual transmission clear indication.
 - 5) Communications failure with central station or FACU.
- d. Digital data transmission must include the following:
 - 1) Address of alarm-initiating device.
 - 2) Address of supervisory signal.
 - 3) Address of trouble-initiating device.
 - 4) Loss of ac supply.
 - 5) Loss of power.
 - 6) Low battery.
 - 7) Abnormal test signal.
 - 8) Communication bus failure.
- e. Secondary Power: Integral rechargeable battery and automatic charger.
- f. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
 - 1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Preinstallation Testing: Perform verification of functionality of installed components of existing system prior to starting work. Document equipment or components not functioning as designed.
- B. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service in accordance with requirements indicated:
 - 1. Notify Architect Construction Manager Owner no fewer than seven Insert number days in advance of proposed interruption of fire-alarm service.
 - 2. Do not proceed with interruption of fire-alarm service without Owner's written permission.
- C. Protection of In-Place Conditions: Protect devices during construction unless devices are placed in service to protect facility during construction.

3.3 INSTALLATION OF EQUIPMENT

- A. Comply with NECA 305, NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
 - 1. Devices placed in service before other trades have completed cleanup must be replaced.
 - 2. Devices installed, but not yet placed, in service must be protected from construction dust, debris, dirt, moisture, and damage in accordance with manufacturer's written storage instructions.
- B. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of building.
 - 2. Connect new equipment to existing monitoring equipment at supervising station.
 - 3. Expand, modify, and supplement existing control monitoring equipment as necessary to extend existing control monitoring functions to new points. New components must be capable of merging with existing configuration without degrading performance of either system.
- C. Equipment Floor Mounting: Install FACU on concrete base. Comply with requirements for concrete base specified in Section 033000 "Cast-in-Place Concrete."
 - 1. Install seismic bracing. Comply with requirements in Section 270548.16 "Seismic Controls for Communications Systems."
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inch centers around full perimeter of concrete base.
 - 3. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
- D. Equipment Floor and Wall Mounting: Install FACU on finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- E. Install wall-mounted equipment, with tops of cabinets not more than 78 inch above finished floor.
1. Comply with requirements for seismic-restraint devices specified in Section 270548.16 "Seismic Controls for Communications Systems."
- F. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in normal path of egress within 60 inch of exit doorway.
 2. Mount manual fire-alarm box on background of contrasting color.
 3. Operable part of manual fire-alarm box must be between 42 and 48 inch above floor level. Devices must be mounted at same height unless otherwise indicated.
- G. Smoke- and Heat-Detector Spacing:
1. Comply with "Smoke-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with "Heat-Sensing Fire Detectors" section in "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. Smooth ceiling spacing must not exceed 30 ft.
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas must be determined in accordance with Annex A in NFPA 72.
 5. HVAC: Locate detectors not closer than 36 inch from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inch from lighting fixture and not directly above pendant mounted or indirect lighting.
- H. Install cover on each smoke detector that is not placed in service during construction. Cover must remain in place except during system testing. Remove cover prior to system turnover.
- I. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend full width of duct. Tubes more than 36 inch long must be supported at both ends.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- J. Remote Status and Alarm Indicators: Install in visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

- K. Audible Alarm-Indicating Devices: Install not less than 6 inch below ceiling. Install bells and horns on flush-mounted back boxes with device-operating mechanism concealed behind grille. Install devices at same height unless otherwise indicated.
- L. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inch below ceiling. Install devices at same height unless otherwise indicated.
- M. Device Location-Indicating Lights: Locate in public space near device they monitor.

3.4 ELECTRICAL CONNECTIONS

- A. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
- B. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- C. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
- D. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.
 - 1. Nameplate must be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."
 - 2. Nameplate must be laminated acrylic or melamine plastic signs with black background and engraved white letters at least 1/2 inch high.

3.5 CONTROL CONNECTIONS

- A. Install control and electrical power wiring to field-mounted control devices.
- B. Connect control wiring in accordance with Section 260523 "Control-Voltage Electrical Power Cables."
- C. Install nameplate for each control connection, indicating field control panel designation and I/O control designation feeding connection.

3.6 PATHWAYS

- A. Pathways above recessed ceilings and in inaccessible locations may be routed exposed.
 - 1. Exposed pathways located less than 96 inch above floor must be installed in EMT.
- B. Pathways must be installed in EMT.
- C. Exposed EMT must be painted red enamel.

3.7 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
 - 1. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- B. Make addressable connections with supervised interface device to the following devices and systems. Install interface device less than 36 inch from device controlled. Make addressable confirmation connection when such feedback is available at device or system being controlled.
 - 1. Smoke dampers in air ducts of designated HVAC duct systems.
 - 2. Magnetically held-open doors.
 - 3. Supervisory connections at valve supervisory switches.

3.8 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 270553 "Identification for Communications Systems."
- B. Install framed instructions in location visible from FACU.

3.9 GROUNDING

- A. Ground FACU and associated circuits in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
- B. Ground shielded cables at control panel location only. Insulate shield at device location.

3.10 FIELD QUALITY CONTROL

- A. Field tests must be witnessed by Architect authorities having jurisdiction.
- B. Adminstrant for Tests and Inspections:
 - 1. Engage qualified testing agency to administer and perform tests and inspections.
 - 2. Engage factory-authorized service representative to administer and perform tests and inspections on components, assemblies, and equipment installations, including connections.
 - 3. Administer and perform tests and inspections with assistance of factory-authorized service representative and authority having jurisdiction.
- C. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.

- a. Inspection must be based on completed record Drawings and system documentation that is required by "Completion Documents, Preparation" table in "Documentation" section of "Fundamentals" chapter in NFPA 72.
 - b. Comply with "Visual Inspection Frequencies" table in "Inspection" section of "Inspection, Testing and Maintenance" chapter in NFPA 72; retain "Initial/Reacceptance" column and list only installed components.
 2. System Testing: Comply with "Test Methods" table in "Testing" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Test audible appliances for public operating mode in accordance with manufacturer's written instructions. Perform test using portable sound-level meter complying with Type 2 requirements in ASA S1.4 Part 1/IEC 61672-1.
 4. Test audible appliances for private operating mode in accordance with manufacturer's written instructions.
 5. Test visible appliances for public operating mode in accordance with manufacturer's written instructions.
 6. Factory-authorized service representative must prepare "Fire Alarm System Record of Completion" in "Documentation" section of "Fundamentals" chapter in NFPA 72 and "Inspection and Testing Form" in "Records" section of "Inspection, Testing and Maintenance" chapter in NFPA 72.
- D. Reacceptance Testing: Perform reacceptance testing to verify proper operation of added or replaced devices and appliances.
- E. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- F. Prepare test and inspection reports.
- G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
- H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.
- 3.11 DEMONSTRATION
- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Provide video recording of training to Owner.
- 3.12 MAINTENANCE
- A. Maintenance Service: Beginning at Substantial Completion, maintenance service must include 12 months' full maintenance by skilled employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies must be manufacturer's authorized replacement parts and supplies.

1. Include visual inspections in accordance with "Visual Inspection Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
2. Perform tests in "Test Methods" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.
3. Perform tests per "Testing Frequencies" table in "Testing" paragraph of "Inspection, Testing and Maintenance" chapter in NFPA 72.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement must include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within two years from date of Substantial Completion. Upgrading software must include operating system and new or revised licenses for using software.
 1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

END OF SECTION 284621.11

SECTION 31 10 00 SITE CLEARING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Clearing and grubbing.
- B. Selective removal and trimming.
- C. Debris removal.

1.02 RELATED REQUIREMENTS

- A. Section 02 41 00 - Demolition: Removal of built elements and utilities.
 - 1. Removal of paving and removal if indicated of abandoned utilities.
 - 2. Within building footprint, removal of designated walls, partitions, and other elements; capping and identifying utilities; and removal of concrete foundations.
 - 3. Sitework (Area of Work), removal of designated fences, walls, and other elements; capping and identifying utilities; landscape paving, and removal of concrete foundations.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1910.266 - Logging Operations; Current Edition.
- B. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.
- C. ANSI A300 Part 5 - American National Standard for Tree Care Operations – Tree, Shrub and Other Woody Plant Maintenance Standard Practices (Management of Trees and Shrubs During Site Planning, Site Development, and Construction); 2019.
- D. ANSI A300 Part 6 - Tree, Shrub, and Other Woody Plant Management--Standard Practices (Planting and Transplanting); 2012 (Reapproved 2018).
- E. ANSI Z133 - American National Standard for Arboricultural Operations - Safety Requirements; 2017.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene prework meeting one week prior to start of work of this section; require attendance by affected personnel.
- B. Sequencing: Ensure utility disconnections are in orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Site Plan:
 - 1. Indicate vegetation removal limits.
 - 2. Indicate areas for temporary construction and field offices.
- C. Clearing Firm Qualification Statement: Documentation of specialized experience.
- D. TCIA Installer Qualification Statement: Documentation of Tree Care Industry Association Accreditation.
- E. Photographs: Photographic documentation of existing vegetation.

1.06 QUALITY ASSURANCE

- A. Clearing Firm Qualifications: Company specializing in performing work of type specified and with at least five years of documented experience.

1.07 FIELD CONDITIONS

- A. Ambient Conditions: Terminate work during hazardous environmental conditions according to 29 CFR 1910.266.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Sedimentation Barrier: See Section 01 57 13 - Temporary Erosion and Sediment Control (SWPP).
- B. Tree Wound Compound: Application capable of sealing vegetation wounds and grafts.
- C. Tree Stump Killer: Application capable of preventing tree regrowth.
- D. Additional materials shall be at the Contractor's option.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Comply with additional requirements specified in Section 01 70 00 - Execution and Closeout Requirements.
- B. Identify potential runoff areas.
- C. Identify potential dust sources.

3.02 PREPARATION

- A. Coordinate work with utility companies; notify before starting work and comply with local requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Protect existing structures and other elements that are to remain.
- E. Protect existing vegetation to remain from damage and monitor according to ANSI A300 Part 5.
- F. Install sedimentation barrier according to Section 01 57 13 - Temporary Erosion and Sediment Control (SWPP).
- G. Develop dust remediation controls and methods. Do not use water if that results in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.

3.03 CLEARING

- A. Perform clearing Work within confines of Project area indicated on Drawings or specified elsewhere herein and with strict adherence to the Contract Documents and Geotechnical recommendations.

3.04 CLEARING AND GRUBBING

- A. Scope: Remove trees, shrubs, brush, and stumps in areas to be covered by building structure, paving, lawns, and planting beds.
- B. Clear site after relocating vegetation in accordance with ANSI A300 Part 6.
- C. Do not remove or damage vegetation beyond limits indicated on drawings.
- D. Remove only trees within area to be cleared that have been marked for removal. Confirm trees to be removed with District and Architect before beginning removal process.
 - 1. Cut trunks close and parallel to ground.
 - 2. Remove roots where under or within five feet of proposed structures.
 - 3. Neither remove nor prune trees and shrubbery in public rights-of-way except by written approval of authorities having jurisdiction.
- E. In areas where vegetation must be removed but no construction will occur other than pervious paving, remove vegetation with minimum subsoil disturbance.

3.05 SELECTIVE REMOVAL AND TRIMMING

- A. Selective Removal: Individual tree and shrub identified for removal as indicated on drawings according to 29 CFR 1910.266.
 - 1. Cut stump neatly and close to ground. Apply tree stump killer according to manufacturer's recommendations.
- B. Selective Trimming: Individual limbs and branches cut back according to ANSI A300 Part 1 identified for removal as indicated on drawings. Follow recommendations of ANSI Z133 and best local practices for species involved.
- C. Damaged Vegetation:
 - 1. Neatly prune damaged branches and severed roots.
 - 2. Apply wound paint to above-ground cuts and abrasions.
 - 3. If trees and shrubs indicated to remain are damaged excessively, as determined by DSA, Architect or authorities having jurisdiction, remove and replace damaged plants with comparable plants.

3.06 REMOVED VEGETATION PROCESSING

- A. Do not burn, bury, landfill, or leave on-site, except as indicated on drawings.
- B. Trees: Sell if marketable.

3.07 GRUBBING

- A. At pipelines, remove all trees or stumps within five feet of the pipeline.
- B. Perform grubbing where indicated on Drawings or as specified herein. Grubbing shall include removal from the ground of all stumps, roots, buried logs and other vegetation not otherwise indicated to remain, and removal and disposal of resulting refuse.
- C. Completely grub areas where unsuitable surface material is to be removed.

3.08 DEBRIS REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Remove logs, rocks and other debris.
- C. Dispose of Debris resulting from clearing and thoroughly clean rights-of-way.

- D. Leave site in clean condition, ready for subsequent work.
- E. Clean up spillage and windblown debris from public and private lands.

3.09 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.
- C. Leave site clean and ready to receive work.

3.10 DISPOSAL

- A. Debris Disposal: Dispose of all cleared and grubbed materials in a legal manner off site.
- B. Hazardous Materials:
 - 1. Immediately notify the Construction Manager should hazardous materials or suspected hazardous materials be encountered.
 - 2. Dispose of such materials in accordance with all applicable laws and regulations and as directed by authorities having jurisdiction.
 - 3. Unforeseen conditions will be resolved in accordance with the Conditions of the Contract.
- C. Saleable Materials:
 - 1. Unless otherwise indicated, all felled trees from which merchantable lumber or firewood can be produced shall become the property of the Contractor.
 - 2. Unless otherwise indicated, all metallic debris of salvageable value shall become the property of the Contractor.
 - 3. The Contractor shall remove all saleable materials from the site in a timely manner.
 - 4. Sale of salvaged and merchantable materials shall be done on site only with prior approval of the District.
- D. Stockpiling Vegetation: Only if specified or indicated under landscape work, stockpile vegetation for subsequent mulching.
- E. Burial and Burning: Debris shall not be buried or burned on site.

3.11 DUST CONTROL

- A. Refer to requirements of:
 - 1. Section 01 50 00 - Temporary Facilities and Controls.
 - 2. Section 31 22 00 - Grading.
- B. Minimize dust during clearing and grubbing to protect adjoining property and vehicles parked in the vicinity.
- C. Clean-up: Keep public thoroughfares clear of dust and debris by periodic sweeping and washing down, at least daily at the end of working hours.

END OF SECTION

SECTION 31 22 00 GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Coordinate work of this Section to compliment and coordinate with field conditions and Civil Drawing noted specific referenced requirements. Utilize the most stringent requirements.
- B. Rough grading and consolidation/compaction the site for site structures.
 - 1. Preparation for excavation, trenching, backfilling and compacting Work.
- C. Fine grading.
- 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.

1.02 RELATED REQUIREMENTS

- A. Section 01 40 00 - Quality Requirements.
- B. Section 01 45 33 - Code-Required Special Inspections.
- C. Section 01 70 00 - Execution and Closeout Requirements.
- D. Section 31 10 00 - Site Clearing.
- E. Section 31 23 16 - Excavation.
- F. Section 31 23 23 - Fill.

1.03 REFERENCE STANDARDS

- A. ASTM D1883 - Standard Test Method for California Bearing Ratio (CBR) of Laboratory-Compacted Soils; 2021.
- B. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).

1.04 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.

1.05 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 locally adopted SSPWC (Greenbook), Public Works Department standards.
 - 1. Maintain one copy on site.

1.06 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 District and for directions to be followed for preservation, relocation or demolition of utilities.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Gravel: Excavated on-site.
 - 1. Graded according to ASTM D2487 Group Symbol GW, GP, or SP.
 - 2. Meeting relative California Bearing Ratio values of 30 to 80 percent according to ASTM D1883.
- 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. 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 survey bench mark and intended elevations for grading areas are as indicated.
- B. Verify the absence of standing or ponding water.
- C. The Drawings do not purport to show all below-grade conditions and objects on the site. Refer to Section 00 31 00 - Available Project Information.
- D. Upon discovery of unknown utility or concealed conditions, discontinue affected Work and notify DSA, Architect and District for direction. Unforeseen conditions shall be resolved in accordance with the General Conditions.

3.02 PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Stake and flag locations of known utilities.
- C. Locate, identify, and protect above- and below-grade utilities to remain.

1. Maintain and protect existing utilities remaining which pass through Project area.
- D. Notify utility company to remove and relocate utilities, as required.
- E. Provide temporary means and methods to remove standing or ponding water from areas prior to grading.
- F. Protect site features to remain, including but not limited to bench marks, survey control points, and fences.
- G. Remove topsoil in accordance with Section 31 10 00.
- H. Excavate materials in accordance with Section 31 23 16.
- I. Fill and backfill in accordance with Section 31 23 23.

3.03 ROUGH GRADING

- A. Excavate and fill subgrade material to elevations indicated on plans.
- B. Comply with Geotechnical Report and field directives of geotechnical engineer on-site.
- C. Eliminate uneven areas and low spots. Remove debris, roots, branches, stones, in excess of 1 inch in size.
- D. Replace displaced subgrade in accordance with Section 31 23 23.
- E. Remove and replace unsuitable materials as specified fill.
- F. Grade top perimeter of excavations to prevent surface water from draining into excavation.
 1. Provide dewatering of excavations as required to ensure suitable conditions for concrete and backfilling operations.
- G. Uniformly grade areas as shown on Drawings to tolerances specified in this Section..
 1. Evenly grade between points where elevations are shown or between points of Work and existing grades.
- H. Slope rough grade away from building perimeter at gradient indicated.
 1. Unpaved area slope for a distance of 10 feet from the building: Not less than one unit vertical in 20 units horizontal or 5 percent.
 - a. CBC Section 1804A.4.
 2. When supported by soil conditions and climate; slope not less than 1:48 or 2 percent in unpaved areas.
 - a. CBC Section 1804A.4, Exception.
- I. Make grade changes gradual. Blend slopes into level areas.

3.04 FINE GRADING

- A. Scrape and spread subgrade material uniformly smooth and without disruptions as indicated on drawings.
- B. See Section 31 23 23 for final compaction.

3.05 TOLERANCES

- A. Top Surface of Finish Grade: Plus or minus 0.04 foot (1/2 inch).
- B. Top Surface Under Paving: Plus or minus 0.04 foot (1/2 inch) from required elevation.
- C. Top Surface Under Footings and Foundations: Plus 0, minus 0.2 foot (2.4 inch).
- D. Top Surface Under Slabs on Grade: Plus 0, minus 0.04 foot (1/2 inch).

3.06 FIELD QUALITY CONTROL

- A. Field inspections and testing shall be performed in accordance with requirements specified in Section 01 40 00 and 01 45 33.
- B. 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 District and shall be at Contractor's expense.

3.07 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove unused stockpiled subsoil. Grade stockpile area to prevent standing water.
- C. Leave site clean and raked, ready to receive work.

3.08 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

SECTION 31 23 16 EXCAVATION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Excavating for footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Trenching for utilities outside the building to on-site existing utilities.
- C. Temporary excavation support and protection systems.

1.02 RELATED REQUIREMENTS

- A. Document 00 31 00 - Available Project Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 40 00 - Quality Requirements: Inspection of bearing surfaces.
- C. Section 01 50 00 - Temporary Facilities and Controls: Dewatering excavations and water control.
- D. Section 01 70 00 - Execution and Closeout Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring. General requirements for dewatering of excavations and water control.
- E. Section 02 41 00 - Demolition: Shoring and underpinning existing structures.
- F. Section 31 10 00 - Site Clearing: Vegetation and existing debris removal; topsoil removal.
- G. Section 31 22 00 - Grading: Grading.
- H. Section 31 23 23 - Fill: Fill materials, backfilling, and compacting.

1.03 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction; Current Edition.

1.04 REFERENCE STANDARDS

- A. 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 (Reapproved 2021).

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Temporary Support and Excavation Protection Plan.
- C. Project Record Documents: Record drawings at project closeout according to 01 70 00 - Execution and Closeout Requirements. Show locations of installed support materials left in place, including referenced locations and depths, on drawings.
- D. Shoring Installer's Qualification Statement.
- E. Field Quality Control Submittals: Document visual inspection of load-bearing excavated surfaces.

1.06 QUALITY ASSURANCE

- A. Temporary Support and Excavation Protection Plan:

1. Indicate sheeting, shoring, and bracing materials and installation required to protect excavations and adjacent structures and property.
 2. Include drawings and calculations for bracing and shoring.
 3. Bracing and shoring design to meet requirements of OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
- B. Designer Qualifications: For design of temporary shoring and bracing, employ a Professional Engineer experienced in design of this type of work and licensed in California.
- C. Shoring Installer Qualifications: Company specializing in performing the shoring and bracing work of this section with minimum five years of documented experience.

1.07 COORDINATION OF SPECIFICATION REQUIREMENTS

- A. Coordinate these Specification Section requirements with specifications included on Drawings. Comply with more stringent requirements and with those requirements of authorities having jurisdiction.
- B. Comply in full with the direction (recommendations) given in the Geotechnical Report.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Bedding and Fill to Correct Over-Excavation:
1. See Section 31 23 23 for bedding and corrective fill materials at general excavations.

PART 3 EXECUTION

3.01 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.
- B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.
- C. Call at least Two (2) full working days prior to digging.
- D. If the members (utility companies) have facilities within the work area, they will mark them prior to the start of your excavation and if not, they will let you know there is no conflict. A different color is used for each utility type (electricity is marked in red, gas in yellow, water in blue, sewer in green, telephone and cable TV in orange).
- E. The Law requires to hand expose to the point of no conflict 24 inches on either side of the underground facility, to know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket fines can be as much as \$50,000 per California government code 4216.

3.02 EXAMINATION

- A. Verify that survey bench mark and intended elevations for the work are as indicated.
- B. Survey existing adjacent structures and improvements and establish exact elevations at fixed points to act as benchmarks.

1. Resurvey benchmarks during installation of excavation support and protection systems and notify District if any changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.
- C. Determine the prevailing groundwater level prior to excavation. If the proposed excavation extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by Architect. If the proposed excavation extends more than 1 foot into the prevailing groundwater, control groundwater intrusion with a comprehensive dewatering procedures, or as directed by Geotechnical Engineer.

3.03 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 10 00 for clearing, grubbing, and topsoil removal.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by Architect.
- F. See Sections 01 70 00 and 02 41 00 for underpinning and shoring of adjacent structures that could be damaged by excavating work.

3.04 TEMPORARY EXCAVATION SUPPORT AND PROTECTION

- A. Excavation Safety: Comply with OSHA's Excavation Standard, 29 CFR 1926, Subpart P.
 1. Excavations in stable rock or in less than 5 feet in depth in ground judged as having no cave-in potential do not require excavation support and protection systems.
 2. Depending upon excavation depth, time that excavation is open, soil classification, configuration and slope of excavation sidewalls, design and provide an excavation support and protection system that meets the requirements of 29 CFR 1926, Subpart P:
 - a. Sloping and benching systems.
 - b. Support systems, shield systems, and other protective systems.
- B. Shoring Design: Comply with State of California Trenching and Shoring Manual issued by Offices of Structure Construction; 2011.
 1. 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.
- C. Underpin adjacent structures that could be damaged by excavating work, including utilities and pipe chases.
- D. Protect excavations from cave-in and from loose soil and other matter from falling in.
- E. Leave excavation support and protection systems, used as formwork or within 10 feet of existing foundations, permanently in place, unless otherwise noted.
 1. Cut off top 4 feet below grade, abandon remainder.
- F. Excavation support and protection systems not required to remain in place may be removed subject to approval of District or District's Representative.
 1. Remove temporary shoring and bracing in a manner to avoid harmful disturbance to underlying soils and damage to buildings, structures, pavements, facilities and utilities.

3.05 EXCAVATING

- A. Excavate to accommodate new structures, paving/site structures, construction operations, and paving/site structures.
 - 1. Excavate to the specified elevations.
 - 2. Excavate to the length and width required to safely install, adjust, and remove any forms, bracing, or supports necessary for the installation of the work.
 - 3. Cut utility trenches wide enough to allow inspection of installed utilities.
 - 4. Hand trim excavations. Remove loose matter.
 - 5. Excavate subsoil from areas to be filled with structural fill, to construct foundations, footings, slabs on grade, paving and to achieve final finish grades.
 - 6. Over-excavate to working elevations for backfilling and compaction operations.
 - 7. Specific Site / Geotechnical requirements: See the geotechnical report for detailed requirements.
 - a. Building Footprint:
 - 1) Within the footprint of proposed buildings, remove/over-excavate and recompact the upper 4 feet of soils below existing grade, or 2 feet below bottom of footings/slab-on-grade, whichever is deeper.
 - 2) Extend over-excavation and recompaction a minimum horizontal distance of 5 feet from perimeter edges of proposed buildings.
 - 3) Localized areas of deeper removals/over-excavation may be required depending on the actual conditions encountered pending verification by the geotechnical engineer during grading to confirm suitable bottom.
 - b. Flatwork/Hardscape/Pavement
 - 1) In areas of proposed concrete flatwork or pavement, provide a minimum over-excavation and recompaction of 2 feet below existing grade or 12 inches below proposed subgrade elevation, whichever is deeper.
 - 2) Extend over-excavation and recompaction a minimum horizontal distance of 2 feet from outside hardscape limits.
 - 3) Proof-roll the bottom of the removal with heavy equipment to identify yielding subgrade conditions (for additional removal, if necessary) under the observation of the geotechnical consultant.
 - c. After completion of the removal of existing fill soils and prior to fill placement, scarify the exposed surface to a minimum depth of 8 inches, moisture condition as necessary to near optimum moisture content and recompact using heavy compaction equipment to an unyielding condition.
 - d. Compact all structural fill within the building footprints throughout to at least 90 percent of the ASTM D1557 laboratory maximum density, at or slightly above optimum moisture.
 - e. Compact all fill within the pavement and hardscape area throughout to at least 90 percent of the ASTM D1557 laboratory maximum density, at or slightly above optimum moisture..
 - 8. 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.

- a. Correct unauthorized and erroneous excavation at no change in Contract Time or Contract Sum.
 - b. All over-excavations should extend to a depth where the project geologist, engineer or his representative has deemed the exposed soils as being suitable for receiving compacted fill. The materials exposed at the bottom of excavations should be observed by a representative of the geotechnical engineer or geologist from our office prior to the placement of any compacted fill soils to verify that all old fill is removed. Additional removals may be required as a result of observation and/or testing of the exposed subgrade subsequent to the required over-excavation.
- 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 to angle of repose or less until shored, per CalOSHA requirements for Type C Soil.
 - 1. Machine slope banks of excavations to minimum 1 to 1 ratio horizontal to vertical or angle of repose, if less, until shored.
 - a. Exception: If authorized in writing by Geotechnical Engineer.
 - b. Slope must comply with local codes, ordinances and requirements of agencies having jurisdiction.
 - c. See Section 00 31 00 - Available Project Information.
- D. Do not interfere with 45 degree influence line of bearing splay of foundations.
 - 1. Avoid interference at footings by providing additional width, depth, and other provisions.
- E. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.
- F. Provide temporary means and methods, as required, to remove all water from excavations until directed by Architect. Remove and replace soils deemed suitable by classification and which are excessively moist due to lack of dewatering or surface water control.

3.06 SUBGRADE PREPARATION

- A. See Section 31 23 23 for subgrade preparation at general excavations.

3.07 FILLING AND BACKFILLING

- A. Do not fill or backfill until all debris, water, unsatisfactory soil materials, obstructions, and deleterious materials have been removed from excavation.
- B. See Section 31 23 23 for fill, backfill, and compaction requirements at general excavations.
- C. See Section 31 22 00 for rough and fine grading.

3.08 REPAIR

- A. Correct areas that are over-excavated and load-bearing surfaces that are disturbed; see Section 31 23 23 at no additional cost.

3.09 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 by Architect and geotechnical consultant before placement of foundations.
- C. Scarification, over excavation and all other excavations will be subject to the approval of the Geotechnical Engineer.

3.10 CLEANING

- A. Stockpile excavated material to be re-used in area designated on site in accordance with Section 31 22 00.
- B. Remove excavated material that is unsuitable for re-use from site.
- C. Remove excess excavated material from site.
 - 1. Geotechnical engineer or other consultant as selected by District to test soils prior to export for disposition.

3.11 PROTECTION

- A. Divert surface flow from rains or water discharges from the excavation.
- B. Prevent displacement of banks and keep loose soil from falling into excavation; maintain soil stability.
- C. Protect open excavations from rainfall, runoff, freezing groundwater, or excessive drying so as to maintain foundation subgrade in satisfactory, undisturbed condition.
- D. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.
- E. Keep excavations free of standing water and completely free of water during concrete placement.

END OF SECTION

SECTION 31 23 16.13 TRENCHING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Backfilling and compacting for utilities from 5 FEET outside the building to connection point on-site, where indicated on Drawings.

1.02 RELATED REQUIREMENTS

- A. 00 31 00 - Available Project Information: Geotechnical report; bore hole locations and findings of subsurface materials.
- B. Section 01 41 00 - Regulatory Requirements: Code Compliance.
- C. Section 31 22 00 - Grading: Site grading.
- D. Section 31 23 16 - Excavation: Building and foundation excavating.
- E. Section 31 23 23 - Fill: Backfilling at building and foundations.
- F. Section 33 14 16 - Site Water Distribution Piping: Potable Water Systems.
- G. Section 33 31 13 - Site Sanitary Sewerage Piping: Sewer piping from building to municipal sewer.
- H. Section 33 42 11 - Stormwater Gravity Piping: Storm drainage piping from building to on-site or off-site storm drain system.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCES

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- B. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- C. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- E. 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 (Reapproved 2021).
- F. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
- G. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
- H. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.

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 Drawings. Comply with more stringent requirements and with those requirements of the authorities having jurisdiction.

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.
 - 1. Free of lumps larger than 3 inches, rocks larger than 2 inches, and debris.
- E. Concrete for Fill: Lean concrete.
- F. Granular Fill - Gravel: Pit run washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM C136/C136M, within the following limits:
 - a. 3/4 inch 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.

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 DIG ALERT NOTIFICATION

- A. Before any excavation in or near the public right-of-way, contact the Underground Service Alert of Southern California (Dig Alert) at 811 for information on buried utilities and pipelines.
- B. Delineation of the proposed excavation site is mandatory. Mark the area to be excavated with water soluble or chalk based white paint on paved surfaces or with other suitable markings such as flags or stakes on unpaved areas.
- C. Call at least Two (2) full working days prior to digging.
- D. If the members (utility companies) have facilities within the work area, they will mark them prior to the start of your excavation and if not, they will let you know there is no conflict. A different color is used for each utility type (electricity is marked in red, gas in yellow, water in blue, sewer in green, telephone and cable TV in orange).
- E. The Law requires to hand expose to the point of no conflict 24 inches on either side of the underground facility, to know its exact location before using power equipment.
- F. If caught digging without a Dig Alert ticket fines can be as much as \$50,000 per California government code 4216.

3.02 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

3.03 PREPARATION

- A. Identify required lines, levels, contours, and datum locations.
- B. See Section 31 22 00 for additional requirements.
- C. Locate, identify, and protect utilities that remain and protect from damage.
- D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- E. Protect plants, lawns, rock outcroppings, and other features to remain.
- F. Grade top perimeter of trenching area to prevent surface water from draining into trench. Provide temporary means and methods, as required, to maintain surface water diversion until no longer needed, or as directed by the Architect.

3.04 TRENCHING

- A. Excavate subsoil required for conduits, storm drain, sanitary sewer, water and gas piping to municipal utilities.
 - 1. Pipe Depths:
 - a. Domestic Water:
 - 1) PVC: 36 inches plus pipe diameter plus 4 inch bedding.
 - 2) Other: 36 inches plus pipe diameter plus 4 inch bedding.
 - b. Sewer: Minimum 30 inches plus pipe diameter plus 4 inch bedding.
 - c. Storm Drain: Minimum 24 inches plus pipe diameter plus 4 inch bedding.
 - d. Irrigation Water:
 - 1) 3 inch diameter or less: 18 inches plus pipe diameter plus 2 inch bedding.

- 2) 4 inch diameter or more: Same as domestic water.
- 2. Trench Widths:
 - a. Domestic Water: 8 inches plus pipe diameter, min.
 - b. Sewer: 6 inches plus pipe diameter min.
 - c. Storm Drain: 6 inches plus pipe diameter, min..
 - d. Gas: 8 inches plus pipe diameter, min.
- 3. Joint Trench:
 - a. Joint trenches are allowed in accordance with the current edition of the SSPWC (Greenbook) and local jurisdiction standards.
 - b. Submit a trench plan to the project engineer for approval prior to proceeding with joint trenches not shown on the plans. Do not assume joint trenches are allowed during bidding, unless joint trenches are shown on the Drawings.
- 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 to angle of repose or less until shored.
- D. Trenches Parallel to Footings: Do not place the trench below a 1 vertical to 2 horizontal from 9 inches above the bottom edge of the footing and no closer than 18 inches from the face of footing. CBC Section 1809A.14.
- E. Do not interfere with 45 degree bearing splay of foundations.
- F. Cut trenches wide enough to allow inspection of installed utilities.
- G. Hand trim excavations. Remove loose matter.
 - 1. Hand trim for bell and spigot pipe joints.
- H. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- I. Remove lumped subsoil, boulders, and rock up to 1/3 cubic yard measured by volume.
- J. Remove excavated material that is unsuitable for re-use from site.
- K. Stockpile excavated material to be re-used in area designated in Section 31 22 00.
- L. Remove excess excavated material from site.
- M. Provide temporary means and methods, as required, to remove all water from trenching until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- N. Determine the prevailing groundwater level prior to trenching. If the proposed trench extends less than 1 foot into the prevailing groundwater, control groundwater intrusion with perimeter drains routed to sump pumps, or as directed by the Architect.

3.05 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.

3.06 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 as as to achieve 90 percent relative compaction 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 compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth or as directed by the Geotechnical Report.
- H. Slope grade away from building minimum 2 inches in 10 feet, 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:
 - 1. Under paving 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.

3.07 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 lifts to 95 percent of maximum dry density.

3.08 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1.2 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1.2 inch from required elevations.

3.09 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.
- C. See Section 31 23 23 - Fill for compaction density testing.
- D. Correct unauthorized excavation at no cost to District.

- E. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D1557 ("modified Proctor"), AASHTO T 180, or ASTM D698 ("standard Proctor").
- F. If tests indicate work does not meet specified requirements, remove work, replace and retest at no additional cost to District.
- 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.

3.10 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.

3.11 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

SECTION 31 23 23

FILL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Filling, backfilling, and compacting for footings, slabs-on-grade, paving, site structures, and utilities within the building.
- B. Backfilling and compacting for utilities outside the building to on-site utility connections.

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 32 91 19 - Landscape Grading.

1.03 DEFINITIONS

- A. Finish Grade Elevations: Indicated on drawings.
- B. Subgrade Elevations: Indicated on drawings.

1.04 REFERENCE STANDARDS

- A. ASTM D4829 - Standard Test Method for Expansion Index of Soils; 2011.
- B. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- C. 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 (Reapproved 2021).
- D. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
- E. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
- F. DTSC-Clean Fill - California Department of Toxic Substances Control - Clean Imported Fill Material; Current.
- G. Greenbook - Greenbook: Standard Specifications for Public Works Construction; latest adopted edition.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Soil Samples: 10 pounds 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 District.
- C. Materials Sources: Submit name of imported materials source.
- D. Fill Composition Test Reports: Results of laboratory tests on proposed and actual materials used, including manufactured fill.

- E. Compaction Density Test Reports.
- F. Manufacturer's Instructions.
- G. Manufacturer's Qualification Statement.
- H. Specimen Warranty.
- I. Provide proof that all imported materials conform to the requirements of DTSC-Clean Fill Imported Fill Materials for School Sites by proper documentation for the imported materials.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than ten years of documented experience.
- B. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- C. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

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 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.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 FILL MATERIALS

- A. All fill materials will be in conformance with the Soils Report, addenda and geotechnical data indicated in Section 00 31 00 - Available Project Information.
- B. General Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of lumps larger than 3 inches, rocks larger than 3 inches, and debris.
 - 3. Complying with ASTM D2487 Group Symbol CL.
- C. Structural Fill: Subsoil excavated on-site.
 - 1. Graded.
 - 2. Free of organic matter, debris, and oversize particles (e.g., cobbles, rubble, etc. that are larger than 3 inches, rocks larger than 3 inches. 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-Clean Fill protocols. Submit to Geotechnical Engineer.
 - a. Import sandy soil shall be free of organics, debris and oversize particles (e.g., cobbles, rubble, rocks, etc. that are greater than 3 inches in the largest dimension).

- b. Additionally, import soils shall not have any corrosion impacts to buried concrete; and be non-expansive (Expansion Index less than 21 per ASTM D4829).
 - c. Prior to import, geotechnical consultant shall evaluate and test the import soils in order to confirm the quality of the material.
- 4. On-site soils should only be used as specified in the Soils Report.
- 5. Complying with ASTM D2487 Group Symbol CL.
- D. Concrete for Fill: See Section 03 30 00; compressive strength of 2,500 psi.
 - 1. Exception: Concrete used under footings and foundations to correct over-excavation shall be same as for footings and foundation.
- E. Granular Fill- Fill Type GM, GW: Coarse aggregate, conforming to Uniform Standard Specifications for Public Works Construction Off-Site Improvements standard.
- F. Granular Fill - Pea Gravel: Natural stone; washed, free of clay, shale, organic matter.
 - 1. Grade in accordance with ASTM D2487 Group Symbol GP.
- G. Sand: Natural river or bank sand; 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. Type F - Subsoil: Reused, free of rocks larger than 3 inch size, and debris.
 - 1. Existing fill and alluvium or older alluvium may be considered suitable for re-use as compacted fills provided the recommendations of the geotechnical report and observations of the geotechnical engineer are followed.

2.02 ACCESSORIES

- A. Geotextile Fabric: Non-biodegradable, non-woven; Geotex 801 manufactured by Propex Geotextile Systems, geotextile.com.

2.03 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-Clean Fill 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. Test soil for potential contamination in accordance with DTSC-Clean Fill protocols.
 - 2. Provide imported fill materials compatible with on-site soils in addition to being suitable for its intended use with the following criterion, as allowed by the Geotechnical Engineer.
 - a. Predominantly granular in nature.

- b. Containing no rocks larger than 3 inches maximum dimension.
- c. Free of organic material (loss on ignition less-than 2 percent).
- d. Very low expansion potential (with an Expansion Index less than 21).
- e. Low corrosion impact to the proposed improvements.
- B. Verify that survey bench marks 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 subdrainage, dampproofing, or waterproofing installation has been inspected.
- F. Verify structural ability of unsupported walls to support imposed loads by the fill.
- G. Verify areas to be filled are not compromised with surface or ground water.

3.02 PREPARATION

- A. Scarify and proof roll subgrade surface to a depth of 8 inches to identify soft spots.
- B. Cut out soft areas of subgrade not capable of compaction in place. Backfill with AWS D1.4/D1.4M Type II 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 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.
 - 1. Place fill soils compacted in horizontal lifts to a relative compaction of 90 percent or more in general accordance with ASTM D1557.
 - 2. Lift thickness for fill soils will vary depending on the type of compaction equipment used but should generally be placed in horizontal lifts not exceeding 8 inches in loose thickness.
 - 3. Place fill soils at slightly above optimum moisture content as evaluated by ASTM D1557.
 - 4. Avoid damage to wet and dry utility lines when compacting fill and subgrade materials.
- 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 compacted depth.
- G. Soil Fill: Place and compact material in equal continuous layers not exceeding 8 inches compacted depth.
 - 1. Expansive soils (EI>20) are not be placed with the upper 3 feet of subgrade soils. CBC Section 1803A.5.3.

- H. Slope grade away from building minimum 2 inches in 10 feet, 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: 90 percent of maximum dry density.
 - 2. At upper 12 inches beneath vehicular pavements: 95 percent of maximum dry density.
 - 3. At other locations: At least 90 percent of maximum dry density.
- K. Reshape and re-compact fills subjected to vehicular traffic.
- L. Maintain temporary means and methods, as required, to remove all water while fill is being placed as required, or until directed by the Architect. Remove and replace soils deemed unsuitable by classification and which are excessively moist due to lack of dewatering or surface water control.
- M. 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, compacted.
 - 4. Compact to minimum at least 90 percent of maximum dry density.
- C. Under Interior Slabs-On-Grade:
 - 1. Comply with CALGreen Section 4.505.2.1 Capillary Break and ACI 302.2R.
 - 2. Use granular fill. Type Class 2 Aggregate base or No. 8 or No. 89, 1/2 inch or larger.
 - 3. Depth: 4 inches deep.
 - 4. Compact to at least 90 percent of maximum dry density.
- D. 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 lifts to at least 90 percent of maximum dry density. Compact to at least 95 percent in subgrade zone.
- E. At Planting Areas Other Than Lawns :
 - 1. Use general fill.
 - 2. Fill up to finish grade elevations.
 - 3. Compact to at least 90 percent of maximum dry density.
 - 4. See Section 32 91 19 for topsoil placement.
- F. Under Monolithic Paving :

1. Compact subsoil to at least 90 percent of its maximum dry density before placing fill.
2. Use general fill.
3. Fill up to subgrade elevation.
4. Compact to at least 90 percent of maximum dry density; , 95 percent in upper 12 inches.
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 from required elevations.
- B. Top Surface of Filling Under Paved Areas: Plus or minus 1/2 inch from required elevations.

3.06 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for general requirements for field inspection and testing.
 1. 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.
- 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.
 2. Allow testing service to inspect and approve each subgrade and fill layer before further fill, backfill or construction Work is performed.
 3. Alternate Density Test Method:
 - a. 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/D1556M.
 - b. In conjunction with each density calibration check, check the calibration curves furnished with the moisture gages in accordance with ASTM D6938.
 - c. 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 District's testing and inspection agency.
- 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. Non-compliance: If tests indicate work does not meet specified requirements, remove work, replace and retest.
 1. Should tests of fill or backfill indicate non-compliance with required density, Contractor shall over-excavate, recompact and retest until specified density is obtained.
 2. Costs and Time associated with remedial Work and retesting shall be in accordance with provisions of the General Conditions.
 3. Retesting to demonstrate compliance shall be by a testing laboratory acceptable to District and shall be at Contractor's expense.
- E. Frequency of Tests:
 1. Footing Subgrade Testing:

- a. For each strata of soil on which footings will be placed, perform at least one in-place density test to verify required design bearing capacities.
 - b. 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.
 3. Foundation Wall Backfill Testing: Perform at least two field density tests at locations and elevations as directed.
- F. Proof roll compacted fill at surfaces that will be under slabs-on-grade.

3.07 CLEANING

- A. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.
- 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 31 63 29 DRILLED CONCRETE PIERS AND SHAFTS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Machine drilled shaft.
- B. Concrete and reinforcement.

1.02 RELATED REQUIREMENTS

- A. Section 03 20 00 - Concrete Reinforcing: Requirements for concrete reinforcement.
- B. Section 03 30 00 - Cast-in-Place Concrete: Requirements for concrete.

1.03 DEFINITIONS

- A. Pier Diameter: Diameter of drilling bucket or auger bit or inside diameter of casing.
- B. Pier Length: Total length of caisson from bottom of wall, grade beam or pier cap to bottom of hole as drilled.
- C. Center of Piers: Intersection of two diameters, one taken parallel to the wall, grade beam, or column line direction, the other taken perpendicular to the first diameter.
- D. The term caissons, piles and piers mentioned in reference to this project within the body of these documents shall always mean "drilled concrete piers and shafts"

1.04 REFERENCE STANDARDS

- A. ACI SPEC-336.1 - Specification for the Construction of Drilled Piers; 2001.

1.05 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.06 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Project Record Documents: Record actual locations of piers, pier diameter, and pier length. Accurately record the following:
 - 1. Sizes, lengths, and locations of piers.
 - 2. Sequence of placement.
 - 3. Final base and top elevations.
 - 4. Deviation from indicated locations.
 - 5. Placement and configuration of reinforcement deviations.

1.07 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years of documented experience.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Tubular Column Type: Round, spirally wound laminated fiber material, surface treated with release agent, non-reusable, of sizes indicated. Provide Sonotube Plus Fiber Forms manufactured by Sonoco Products Co., Hartsville, SC (803)383-7000. Provide wall thickness sufficient to maintain finished concrete surface true within 1/8-inch in 10 feet.]
- B. Concrete Materials and Mix: Specified in Section 03 30 00.
- C. Reinforcement: Specified in Section 03 20 00 - Concrete Reinforcing, 03 30 00 - Cast-in-Place Concrete, and 32 13 13 - Site Concrete; spiral wound.
- D. Equipment: Appropriate for dewatering excavated shaft.

PART 3 EXECUTION

3.01 PREPARATION

- A. Use placement method which will not cause damage to nearby structures.
- B. Notify adjacent and affected land owners and building occupants with 90 days notice before proceeding with the work.
- C. Protect structures near the work from damage.
- D. Prepare to place piers from existing site elevations.
- E. Grade perimeter of pier and shaft area to prevent surface water from draining into soil borings. Provide temporary means and methods, as required, to maintain surface diversion until no longer needed, or as directed by the Architect.

3.02 INSTALLATION

- A. Construct piers in accordance with ACI SPEC-336.1.
- B. Drill vertical pier shafts to diameters and depths indicated.
- C. Clean shaft and bottom of loose material. Provide temporary means and methods, as required, to remove all water from soil borings as needed, or until directed by the Geotechnical Engineer.
- D. Allow inspection of shaft prior to placement of reinforcement and concrete.
- E. Place reinforcing steel in accordance with Section .03 20 00 - Concrete Reinforcing, 03 30 00 - Cast-in-Place Concrete, and 32 13 13 - Site Concrete
- F. Place concrete in single pour, in accordance with Section 03 30 00 with equipment designed for vertical placement of concrete.
- G. Coordinate casing withdrawal with concrete placement so that concrete pressure head exceeds anticipated outside soil and water pressure above bottom of casing at all times during withdrawal.
- H. Extend reinforcement for connection of caps.
- I. Set tops of piers to elevations indicated.

3.03 TOLERANCES

- A. Install piers with maximum variation from location, plumbness, bottom area, diameter, and anchorage locations as specified in ACI SPEC-336.1.
- B. Maximum Variation From Vertical: 1 in 48.

- C. Maximum Variation From Design Top Elevation: Plus 3 inches, minus 1 inch.
- D. Maximum Out-of-Position: 2 inches.

3.04 FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01 40 00 - Quality Requirements.

3.05 UNACCEPTABLE PIERS

- A. Unacceptable Piers: Piers placed out of position, are below elevations, or are damaged.
- B. Provide additional piers or replace piers failing to comply with specified requirements.

END OF SECTION

SECTION 32 01 90 OPERATION AND MAINTENANCE OF PLANTING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Maintain plants in manner that promotes health, growth, color and appearance, to quality levels specified; replace dead, dying, and damaged plants at no extra cost to District.
 - 1. It is Contractor's responsibility to determine type and quantity of soil amendments and fertilizer required.
 - 2. Perform soil analysis to determine type and quantity of soil amendments; test enough soil samples to obtain a comprehensive analysis; submit reports.
- B. Maintain newly planted landscape plants, including turf (lawns), turf (playfields), trees, shrubs, hedges, vines, ground cover, perennials, flowering bulbs, and annuals.
- C. Maintain established landscape plants, including turf (lawns), turf (playfields), trees, shrubs, hedges, vines, ground cover, perennials, and flowering bulbs.
- D. Renovate the following established landscape plants within the project boundaries: turf (lawns), turf (playfields), trees, regardless of size, shrubs, hedges, vines, ground cover, and perennials.
- E. Operate permanent irrigation system.
- F. Clean up landscaped areas.
- G. Maintenance Period: The time frame covered by these requirements is 90 days:
 - 1. Start Date: Project Date of Substantial Completion.

1.02 RELATED REQUIREMENTS

- A. Section 01 57 13 - Temporary Erosion and Sediment Control (SWPP).
- B. Section 31 22 00 - Grading.
- C. Section 32 84 23 - Irrigation System.
- D. Section 32 93 00 - Planting.

1.03 REFERENCE STANDARDS

- A. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.
- B. ANSI Z133.1 - American National Standard for Arboricultural Operations - Safety Requirements; 2017.
- C. ASTM C602 - Standard Specification for Agricultural Liming Materials; 2023.
- D. ASTM D4972 - Standard Test Methods for pH of Soils; 2019.

1.04 PROPOSAL SUBMITTALS

- A. Submit complete maintenance plan, showing:
 - 1. Irrigation volume and frequency.
 - 2. Fertilizer type, quantity, and schedule of application.
 - 3. Soil amendment type, quantity, and schedule of application.

4. Personnel assigned, including supervisor.
5. Inspection procedures, diagnostics, and remedies.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Soil Tests and Analysis: Submit report showing number of samples, test results, and recommendations for soil amendments and fertilizer prior to any planting.
- C. Product Data: Manufacturer's data sheets on each fertilizer, herbicide, pesticide, and other chemical material to be used, showing trade name, chemical composition, mixing instructions, recommended application rate, storage and handling instructions, and application instructions.
 1. Pesticides and Herbicides: Also include U.S. EPA registration number and Material Safety Data Sheets.
- D. Shop Drawings:
 1. Maintenance plan.
 2. Recommendations of the local Cooperative Extension Service office for maintenance and care of turf.
 3. Pesticide application plan; obtain approval of District for each individual pesticide application.
- E. Certificates: Certification of composition of the following as delivered:
 1. Fertilizer.
 2. Mulch.
 3. Pesticides.
 4. Herbicides.
 5. Other chemical materials.
- F. Installer Qualifications: As specified.
- G. Site Reports: Include date, time, personnel, condition of plants, activities, temperature, precipitation, irrigation applied; record:
 1. Each visit for maintenance purposes.
 2. Volume of water applied and area applied to.
 3. Diagnosis for treatment of unhealthy plants.
 4. Pesticide application; provide all additional reports and recordkeeping required by law.
 5. Herbicide application; provide all additional reports and recordkeeping required by law.
 6. Removal of dead plants, with quantity and diagnosis.
 7. Replanting.
 8. Volume of bio-degradable debris composted.
 9. Volume of wood chips produced.
 10. Volume of debris removed from site.

1.06 QUALITY ASSURANCE

- A. Installer Qualifications:
 1. Maintenance Contractor: The contractual entity that performed the planting installation.
 2. Pruners: Certified member, or supervised by certified member, of International Society of Arboriculture.

3. Pesticide Applicators: Certified by authorities having jurisdiction.
4. Herbicide Applicators: Certified by authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver U.S. EPA-controlled materials to site in original containers with legible labels indicating registration number and registered uses.
- B. Deliver fertilizer and manufactured soil amendments to site in original containers bearing manufacturer's chemical analysis, name, trade name or trademark, and indication of compliance with applicable state and federal laws and regulations ; alternatively, bulk delivery with equivalent certificate is acceptable.
- C. Store fertilizer, soil amendments, and mulch in dry locations away from contaminants.
- D. Do not store pesticides, herbicides, or other chemical treatment materials in locations where they could damage seeds or plants.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fertilizers:
 1. Provide product based on soil report recommendations.
- B. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 FERTILIZERS AND SOIL AMENDMENTS

- A. Fertilizers: Free flowing granular organic type containing nitrogen, phosphorus, and potassium, plus trace minerals and micro-nutrients; controlled release type is preferred.
 1. Determine type and quantity based on soil analysis.
- B. Soil Amendments: Type and quantity as required to achieve specified results, based on soil analysis.
- C. pH Adjuster: ASTM C602 Class O limestone.
- D. Gypsum: Commercially packaged, free flowing, minimum 95 percent calcium sulfate by volume.
- E. Sand: Clean and free of materials harmful to plants; 95 percent by weight, minimum, passing No.10 (sieve and 10 percent by weight, minimum, passing No.16 (sieve.
- F. Decomposed Wood Derivatives: Ground bark, sawdust, humus or other green wood waste material; free of stones, sticks, and fully composted or stabilized with nitrogen.
- G. Recycled Compost: Well decomposed, stable, weed free; derived from food, agricultural or industrial residuals, biosolids, yard trimmings, or source-separated or mixed solid waste; with no objectionable odors and not resembling the raw material from which it was made; no substances toxic to plants.
 1. Gradation: 100 percent passing 3/8 inch screen.
 2. Moisture Content: 35 to 55 percent by weight.
 3. pH: 5.5 to 8.9.
 4. Not more than 1 percent man-made matter and without plastic items more than 2 inches in length.
- H. Bonemeal: Finely ground, steamed, with 2 to 4 percent nitrogen and 16 to 40 percent phosphoric acid.

2.03 APPLIED MATERIALS

- A. Antidessicants: Sprayable, water insoluble film-forming material that produces a moisture retarding barrier not removable by rain or snow.
 - 1. Film-Forming Temperature: Temperature commonly encountered out of doors during planting season.
 - 2. Moisture Vapor Transmission: 0.2 pounds per 24 hours at 70 percent humidity, maximum.
- B. Plant Growth Regulators: Sprayable, foliar absorbed non-translocatable liquid; not for application via permanent irrigation system.
- C. Organic Mulch: Maintain general appearance of existing mulched areas; use one of the Nitrolized following types:
 - 1. Wood chips ranging in size from 1/2 inch to one inch.
 - 2. Ground or shredded bark.
 - 3. Shredded hardwood ranging in size from 1/2 inch to one inch.
 - 4. Bark peelings ranging in size from 1/2 inch to one inch.
 - 5. Recovered 100 percent paper-based materials ranging in size from 1/2 inch to one inch.
 - 6. Recovered 100 percent wood-based materials ranging in size from 1/2 inch to one inch.
- D. Inorganic Mulch: Maintain a uniform appearance; existing mulch may be removed; use one of the following types:
 - 1. Riverbank stone ranging in size from 2 inch to 6 inch. See Section 321530 - Decorative Rock.
 - 2. Crushed rock ranging in size from 3/4 inch to 1 inch. See Section 321530 - Decorative Rock.
 - 3. Granite Chips: See Section 33 05 43 - Corrosion Protection
- E. Pesticides: U.S. EPA registered.
 - 1. Insecticide: Submit for review.
 - 2. Rodenticide: Submit for review.
- F. Herbicides for Use on Turf: U.S. EPA registered.
 - 1. Pre-Emergence Type: Do not use.
 - 2. Post-Emergence Type: Submit for review.
- G. Water: Suitable for irrigation; District's water supply may be used.

PART 3 EXECUTION

3.01 EXAMINATION

- A. If soil analysis has not already been performed, take sufficient samples to obtain a comprehensive analysis; perform analysis in accordance with ASTM D4972.

3.02 LANDSCAPE MAINTENANCE - GENERAL

- A. Obtain and follow the maintenance instructions provided by the installer of new plant materials.
- B. Protect existing vegetation, pavements, and facilities from damage due to maintenance activities; restore damaged items to original condition or replace, at no extra cost to District.

- C. General Cleanup: Remove debris from all landscape areas at least once a week and from turf areas before each mowing.
 - 1. Debris consists of trash, rubbish, dropped leaves, downed branches and limbs of all sizes, dead vegetation, rocks, and other material not belonging in landscaped areas.
 - 2. Remove debris from site and dispose of properly.
- D. Watering, Soil Erosion, and Sedimentation Control: Comply with federal, state, local, and other regulations in force; prevent over-watering, run-off, erosion, puddling, and ponding.
 - 1. Site grading and planting have been designed to resist erosion once fully grown, with temporary measures in place during establishment period.
 - 2. Repair temporary erosion control mechanisms provided by others.
 - 3. Repair eroded areas and replant, when caused by inadequate maintenance.
 - 4. Prevent sediment from entering storm drains.
- E. Trees: Exercise care to avoid girdling trees; provide protective collars if necessary; remove protective collars at end of maintenance period.
- F. Fertilizing: Apply fertilizer only when necessary.
- G. Earth Mound Watering/Percolation Basins: Maintain in good condition and as required to permit efficient application of water without waste; reapply mulch if soil surface shows.
- H. Drainage Channels: Remove obstructions in gutters, catch basins, storm drain inlets, yard drains, swales, ditches, and overflows.
 - 1. Remove grates from catch basins to clean.
 - 2. Prevent encroachment of other vegetation on turfed surface drainage channels.
- I. Health Maintenance: Inspect all plants regularly for health:
 - 1. Eradicate diseases and damaging pests, regardless of severity or speed of effect.
 - 2. Treat accidental injuries and abrasions.
 - 3. If a plant is unhealthy but not yet dead, according to specified definitions, determine reason(s) and take remedial action immediately.
 - 4. Remove dead plants immediately upon determining that they are dead.
- J. Pesticide and Herbicide Application: Comply with manufacturer's instructions and recommendations and applicable regulations.
 - 1. Obtain District's approval prior to each application.
 - 2. Apply in manner to prevent injury to personnel and damage to property due to either direct spray or drifting, both on and off District's property.
 - 3. Use backflow preventers on hose bibbs used for mixing water; prevent spills.
 - 4. Inspect equipment daily before application; repair leaks, clogs, wear, and damage.
 - 5. Do not dispose of excess mixed material, unmixed material, containers, residue, rinse water, or contaminated articles on site; dispose of off site in legal manner.
 - 6. Rinse water may be used as mix water for next batch of same formulation.
 - 7. Contractor is responsible for all recordkeeping, submissions, and reports required by laws and regulations.
- K. Replanting: Perform replacement and replanting immediately upon removal of dead plant.

3.03 IRRIGATION

- A. Irrigation: Do not allow plants to wilt; apply water as required to supplement rainfall; do not waste water; do not water plants or areas not needing water; do not water during rainfall; shut off water flow when finished; repair leaks.
 - 1. New automatic irrigation system may be used.
 - 2. District's water source is to be used.
 - 3. Do not drive water trucks over turf, seeded areas, or planting beds.
 - 4. Provide backflow preventers on hose bibbs used for irrigation hoses.
- B. Automatic Irrigation System: Obtain and follow manufacturer's operating and maintenance instructions.
 - 1. Adjust to water landscape areas only.
 - 2. Adjust sprinkler heads, drippers, valves, pumps, and controllers as required for optimum operation to comply with the State Water Ordinance.
 - 3. Drain and prepare for freezing weather; prepare and start up in spring.
 - 4. During system warranty period notify Architect and system installer promptly of defects and leaks that adversely affect irrigation performance.
 - 5. After end of system warranty period, service and repair all defects and leaks.

3.04 RENOVATION OF ESTABLISHED TURF

- A. Remove turf from around trees to radius of 18 inches from base of tree trunk. Cut turf out and remove; do not simply mow. Trim turf edge as specified.
- B. Trim perimeter of turf area and around intervening objects as specified under Turf Maintenance.
- C. Eliminate undesirable grasses and weeds. Remove as much thatch as possible.
- D. Aerate established turf at least once every two years by coring and pulling out soil plugs 2 to 3 inches deep and not more than 2 inches apart.
 - 1. Leave the plugs on the turf until the soil has been washed from them, then remove.
 - 2. Clean plugs from pavements immediately.
- E. Apply fertilizer over entire aerated area.
- F. After aeration, seed entire aerated area as specified in Section 32 92 19; rake or brush seed into contact with soil.
- G. When soil amendments are necessary, apply as top dressing to entire aerated area after overseeding to depth of 1/4 inch; blend top dressing mixture thoroughly before applying.
- H. Water as soon as possible after planting. Do not allow newly planted material to become dry.
- I. Fertilize again 3 to 4 weeks after seeding.
- J. Begin normal mowing once grass reaches 1-1/2 times specified mowing height.

3.05 TURF MAINTENANCE

- A. Maintain turf in manner required to produce turf that is healthy, uniform in color and leaf texture, and free from weeds and other undesirable growth.
 - 1. Obtain and follow the recommendations of local agricultural extension service office.
 - 2. Grass Density - Lawns: 20 plants per square foot, minimum.
 - 3. Bare Spots - Lawns: 2 percent of total area, maximum; 6 inches square, maximum.

4. Bare Spots - Other Than Lawns: 2 percent of total area, maximum.
 5. Keep turf relatively free of thatch, woody plant roots, diseases, nematodes, soil-borne insects, stones larger than 1 inch in diameter, and other materials detrimental to grass growth.
 6. Limit broadleaf weeds and patches of foreign grass to a maximum of 2 percent of the total area.
 7. When new grass is planted in existing turf areas, quality will be evaluated when grass is 1 inch high.
- B. Mowing: During growing season(s) mow turf to uniform height, in manner that prevents scalping, rutting, bruising, and uneven or rough cutting.
1. Prior to mowing clean all debris and leaves from turf surface.
 2. Schedule frequency of mowing so that no more than one-quarter to one-third of grass leaf length is removed during a cutting.
 - a. Maximum grass height before mowing: 4 inches.
 - b. Height of turf is measured from the soil surface.
 3. Make each successive mowing at approximately 45 degrees to the previous mowing, if practical.
 4. Cool Season Grasses:
 - a. Reduce mowing height in fall and spring.
 - b. Use rotary type mowers; mulcher type mowers may be used.
 5. Warm Season Grasses:
 - a. Increase mowing height slightly as fall approaches.
 - b. Use reel type mowers; do not use mulcher mowers.
 6. Removal of grass clippings is not required.
- C. Summer Mowing Height for Lawns:
1. Bermuda, Common: 2 inches.
 2. Bermuda, Hybrid: 1 inches.
 3. Bluegrass: 3 inches.
 4. Fescue, Creeping Red: 3 inches.
 5. Fescue, Fine: 2 inches.
 6. Fescue, Tall: 4 inches.
 7. Rye, Annual: 3 inches.
 8. Rye, Perennial: 3 inches.
 9. St. Augustine, Common: 4 inches.
 10. St. Augustine, Improved: 3 inches.
- D. Mowing Playfields:
1. Mowing Height: 2 inches.
 2. Mowing Frequency: Once a week.
- E. Trimming: Immediately after each mowing, neatly trim perimeter of each turf area and around obstructions within turf area; match height and appearance of adjacent turf.
1. Adjacent to Pavements: Cut edges of turf to form a distinct, uniform turf edge.

2. Adjacent to Planting Beds and Permanently Mulched Areas: Cut edges of turf to form a distinct, uniform turf edge.
3. Around Palm Trees: Do not use string trimmer as it slowly damages the bark, leaving tree susceptible to disease.
4. Around Other Trees and Poles: Where no planting bed or mulched area exists, trimming with string trimmer is acceptable.
5. At Fences: Trim on both sides of fence.
6. Irrigation Heads and Valve Boxes: Trim neatly so grass doesn't interfere with operation.
- F. Fertilizer: Apply as recommended by manufacturer and at rate indicated by soil analysis.
 1. Cool Season Grasses: Apply at least once, in Fall before first frost; do not apply high nitrogen fertilizer during Summer; Spring application is optional but must be reduced in quantity.
 2. Warm Season Grasses: Make two applications, in Spring when grass begins to green up, and in Fall about 6 weeks before average first frost.
- G. Resodding: Comply with requirements of Section 32 92 23.

3.06 PLANTING BED MAINTENANCE

- A. Planting beds include all planted areas except turf.
- B. Begin maintenance immediately after plants have been installed; inspect at least once a week and perform needed maintenance promptly.
- C. Keep planting beds free of pests; remove weeds and grass by hand before reaching 1 inch height.
- D. Do not allow climbing, twining, or creeping plants to encroach into other species.
- E. Ground Cover and Vines:
 1. Trim to encourage dense, well-developed growth covering intended areas.
 2. Do not allow plants to grow up trees, shrubs, or vines or encroach into turf or drainage channels, unless the drainage channel is intended to be planted with ground cover.
 3. Remove existing plants grown up trees, shrubs, and vines.
- F. Flowering Plants: Remove dead flower heads; do not trim off leaves of flowering bulbs until they are brown.
- G. Replace mulch as required and remove debris.

3.07 TREE AND SHRUB MAINTENANCE

- A. Trees will be considered dead when main leader has died back or when 25 percent or more of crown has died ; except as otherwise indicated for palm trees.
- B. Shrubs will be considered dead when 25 percent or more of plant has died.
- C. Inspect woody plants for health by scraping up to 1/16 inch square area of bark; no green cambium layer below bark shall be evidence of death.
- D. Adjust stakes, guys and turnbuckles, ties, and trunk wrap as required to promote growth and avoid girdling.
- E. Fertilizing: Fertilize all trees at least once during maintenance period, preferably in the Fall; use accepted standards for determining type and method of fertilization.

- F. Pruning: Unless otherwise indicated, prune only to maintain balanced natural shape; follow recommendations of ANSI A300 and ANSI Z133.1 and best local practices for species involved.
- G. Shrubs: Prune at least once during maintenance period at best time to influence ultimate shape and size for the particular species.
 - 1. Prune to balance the plant's form and according to its natural growth characteristics.
 - 2. Remove water shoots, suckers, and branches not complying with desired shape and size.
- H. Hedges: Trim to encourage growth into voids and gaps.
- I. Young Trees: Prune at least once during maintenance period at best time to influence ultimate shape and size for the particular species; do not remove or cut off leader.
- J. Palm Trees: Palm trees are extremely susceptible to disease. Wounds in the bark must be avoided as puncture wounds never heal.
 - 1. Remove diseased and damaged fronds and all seed pods and fruit clusters; do not remove any green fronds; cut fronds close to trunk.
 - 2. Unless fronds come off easily, do not pull or rip them off as this causes permanent wounds to the trunk.
 - 3. Preferred tool is manual pruning saw. Do not use a machete to remove fronds as an overstrike will wound the trunk. Be very careful using chain saws for the same reason.
 - 4. Do not use climbing spikes.
 - 5. Prior to pruning each tree, disinfect tools with 50 percent chlorine bleach solution, or other approved disinfectant to prevent transmission of diseases.
- K. Renovation of Established Shrubs: Prune and trim as required to improve shape and balance as appropriate to the particular species; remove dead, damaged, and diseased branches and limbs; do not remove excess growth except as follows:
 - 1. Remove growth in front of windows, above or obstructing entranceways and walkways, leaning against structures, and obstructing vision at street intersections.
 - 2. Where indicated, remove excess growth by pruning technique best suited to future growth for the particular species.
- L. Renovation of Established Trees (Except Palm Trees):
 - 1. Remove dead, damaged, and diseased branches and limbs and structurally weak limbs that may be a safety hazard.
 - 2. Remove growth in front of windows, above or obstructing entranceways and walkways, and leaning against structures.
 - 3. Remove growth obstructing traffic signs or vision at street intersections.
 - 4. Remove branches that extend over buildings or otherwise endanger roofs.
 - 5. Remove low-hanging branches over vehicular traffic routes to height necessary to clear expected traffic including buses and moving vans.
 - 6. Where indicated, remove excess growth by pruning technique best suited to future growth for the particular species.

3.08 CLEANING

- A. Remove fallen deciduous leaves in Fall; removal may wait until all leaves have fallen.
- B. Clean adjacent pavements of plant debris and other debris generated by maintenance activities.

- C. Remove and dispose of general cleanup debris and biodegradable debris in a proper manner; District's trash collection facilities may be used.
- D. Remove and dispose of general cleanup debris and biodegradable debris in a proper manner.
 - 1. Biodegradable Debris: District will designate a compost pile on site where biodegradable debris may be deposited; branches and bark are not considered biodegradable.
 - 2. Branches and Bark: District will designate a wood chip storage area; machine-chip all branch and bark debris.
 - 3. Non-Biodegradable Debris: District's trash collection facilities may be used.

3.09 CLOSEOUT ACTIVITIES

- A. 10 days prior to end of maintenance period, submit request for final inspection.
- B. Final inspection will be conducted by District.

END OF SECTION

SECTION 32 01 90.23 TREE AND PLANT PROTECTION

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Tree protection of existing trees and plants
- B. Tree pruning of existing trees

1.02 RELATED REQUIREMENTS

- A. Division 01 - General Requirements: Temporary Facilities and Controls
- B. Division 31 - Earthwork: Site Clearing.
- C. Division 32 - Exterior Improvements: Landscape Work.

1.03 REFERENCE STANDARDS

- A. ANSI A300 Part 1 - American National Standard for Tree Care Operations - Tree, Shrub, and Other Woody Plant Management - Standard Practices (Pruning); 2017.
- B. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2023.

1.04 DEFINITIONS

- A. Caliper: Diameter of a trunk measured by a diameter tape or the average of the smallest and largest diameters at 6 inches above the ground for trees up to, and including, 4 inch size; and 12 inches above the ground for trees larger than 4 inch size.
- B. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.
- C. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.
- D. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.05 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples for Verification: For each type of the following:
 - 1. Organic Mulch: 1 quart volume of organic mulch; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch.
 - 2. Protection-Zone Fencing: Assembled Samples of manufacturer's standard size made from full-size components.
 - 3. Protection-Zone Signage: Full-size Samples of each size and text, ready for installation.
- C. Tree Pruning Schedule: Written schedule detailing scope and extent of pruning of trees to remain that interfere with or are affected by construction.
 - 1. Species and size of tree.
 - 2. Location on site plan. Include unique identifier for each.
 - 3. Reason for pruning.
 - 4. Description of pruning to be performed.
 - 5. Description of maintenance following pruning.

- D. Qualification Data: For qualified arborist and tree service firm.
- E. Certification: From arborist, certifying that trees indicated to remain have been protected during construction according to recognized standards and that trees were promptly and properly treated and repaired when damaged.
- F. Maintenance Recommendations: From arborist, for care and protection of trees affected by construction during and after completing the Work.
- G. Existing Conditions: Documentation of existing trees and plantings indicated to remain, which establishes preconstruction conditions that might be misconstrued as damage caused by construction activities.
 - 1. Use sufficiently detailed photographs or videotape.
 - 2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

1.06 QUALITY ASSURANCE

- A. Arborist Qualifications:
 - 1. Certified Arborist as certified by ISA.
 - 2. Licensed Arborist in jurisdiction where Project is located.
- B. Tree Service Firm Qualifications: An experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.
- C. Preinstallation Conference: Conduct conference at Project site.
 - 1. Review methods and procedures related to temporary tree and plant protection including, but not limited to, the following:
 - a. Construction schedule. Verify availability of materials, personnel, and equipment needed to make progress and avoid delays.
 - b. Enforcing requirements for protection zones.
 - c. Arborist's responsibilities.
 - d. Contractor responsibilities
 - e. Field quality control.

1.07 PROJECT CONDITIONS

- A. The following practices are prohibited within protection zones:
 - 1. Storage of construction materials, debris, or excavated material.
 - 2. Parking vehicles or equipment.
 - 3. Foot traffic.
 - 4. Erection of sheds or structures.
 - 5. Impoundment of water.
 - 6. Excavation or trenching or digging unless otherwise indicated.
 - 7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.
 - 8. Do not direct vehicle or equipment exhaust toward protection zones.
 - 9. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones and organic mulch.

PART 2 - PRODUCTS

2.01 MATERIALS

- A. Topsoil: Natural or cultivated top layer of the soil profile or manufactured topsoil; containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 1 inch. Insert dimension in diameter; and free of weeds, roots, and toxic and other nonsoil materials.
 - 1. Obtain topsoil only from well-drained sites where topsoil is 4 inches deep or more; do not obtain from bogs or marshes.
 - 2. Refer to Division 32 - Exterior Improvements, "Landscape Work" for material requirements.
- B. Topsoil: Stockpiled topsoil from location shown on Drawings.
- C. Organic Mulch: Free from deleterious materials and suitable as a top dressing for trees and shrubs, consisting of one of the following:
 - 1. Type: Wood and bark chips.
 - 2. Size Range: 1/2 inch minimum, 1 inch maximum.
 - 3. Color: Natural.
- D. Protection-Zone Fencing: Fencing fixed in position and meeting one of the following requirements. Previously used materials may be used when approved by Architect.
 - 1. Chain-Link Protection-Zone Fencing: Galvanized-steel fencing fabricated from minimum 2 inch opening, 0.148 inch diameter wire chain-link fabric; with pipe posts, minimum 2-3/8 inch OD line posts, and 2-7/8 inch OD corner and pull posts; with 1-5/8 inch OD top rails and 0.177 inch diameter bottom tension wire; with tie wires, hog ring ties, and other accessories for a complete fence system.
 - a. Height: 6 feet.
 - b. Polymer-Coating Color: Black.
 - 2. Gates: Single swing access gates matching material and appearance of fencing, to allow for maintenance activities within protection zones; leaf width 36 inches.
- E. Protection-Zone Signage: Shop-fabricated, rigid plastic or metal sheet with attachment holes pre-punched and reinforced; legibly printed with nonfading lettering and as follows:
 - 1. Size: as required
 - 2. Text: "TREE PROTECTION ZONE - KEEP OUT. No unauthorized entry. No storage of vehicles, materials, or debris. No dumping of chemicals, slurry, paint, oil, etc. "
 - 3. Lettering: 3 inch high minimum, black characters on white background.

PART 3 - EXECUTION

3.01 EXAMINATION

- A. Erosion and Sedimentation Control: Examine the site to verify that temporary erosion- and sedimentation-control measures are in place. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.
- B. For the record, prepare written report, endorsed by arborist, listing conditions detrimental to tree and plant protection.

3.02 PREPARATION

- A. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Flag - Tie a 1 inch blue-vinyl tape around each tree trunk at 54 inches above the ground.
- B. Protect tree root systems from damage caused by runoff or spillage of noxious materials while mixing, placing, or storing construction materials. Protect root systems from ponding, eroding, or excessive wetting caused by dewatering operations.
- C. Tree-Protection Zones: Mulch areas inside tree-protection zones and other areas indicated.
 - 1. Apply 3 inch average thickness of organic mulch. Do not place mulch within 6 inches of tree trunks.

3.03 TREE- AND PLANT-PROTECTION ZONES

- A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.
 - 1. Chain-Link Fencing: Install to comply with ASTM F567 and with manufacturer's written instructions.
 - 2. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Architect.
 - 3. Access Gates: Install as required; adjust to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.
- B. Protection-Zone Signage: Install protection-zone signage in visibly prominent locations in a manner approved by Architect. Install one sign spaced approximately every 35 feet on protection-zone fencing, but no fewer than four signs with each facing a different direction.
- C. Maintain protection zones free of weeds and trash.
- D. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
- E. Maintain protection-zone fencing and signage in good condition as acceptable to Architect and remove when construction operations are complete and equipment has been removed from the site.
 - 1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.
 - 2. Temporary access is permitted subject to preapproval in writing by arborist if a root buffer effective against soil compaction is constructed as directed by arborist. Maintain root buffer so long as access is permitted.

3.04 EXCAVATION

- A. General: Excavate at edge of protection zones and for trenches indicated within protection zones according to requirements in Division 31 Section "Earth Moving."

- B. Trenching near Trees: Where utility trenches are required within protection zones, hand excavate under or around tree roots or tunnel under the roots by drilling, auger boring, or pipe jacking. Do not cut main lateral tree roots or taproots; cut only roots smaller than 2" in diameter that interfere with installation of utilities. Cut roots as required for root pruning.
- C. Redirect roots in backfill areas where possible. If encountering large, main lateral roots, expose roots beyond excavation limits as required to bend and redirect them without breaking. If encountered immediately adjacent to location of new construction and redirection is not practical, cut roots approximately 3 inches (75 mm) back from new construction and as required for root pruning.
- D. Do not allow exposed roots to dry out before placing permanent backfill. Provide temporary earth cover or pack with peat moss and wrap with burlap. Water and maintain in a moist condition. Temporarily support and protect roots from damage until they are permanently relocated and covered with soil.

3.05 ROOT PRUNING

- A. Prune roots that are affected by temporary and permanent construction. Prune roots as follows:
 - 1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
 - 2. Cut Ends: Do not paint cut root ends. Coat cut ends of roots more than 1-1/2 inches in diameter with emulsified asphalt or other coating formulated for use on damaged plant tissues as approved by the arborist.
 - 3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
 - 4. Cover exposed roots with burlap and water regularly.
 - 5. Backfill as soon as possible according to requirements in Section 31 22 00 - Grading.
- B. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.
- C. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.

3.06 CROWN PRUNING

- A. Prune branches that are affected by temporary and permanent construction. Prune branches as follows:
 - 1. Prune trees to remain to compensate for root loss caused by damaging or cutting root system. Provide subsequent maintenance during Contract period as recommended by arborist.
 - 2. Pruning Standards: Prune trees according to ANSI A300 Part 1 and the following:
 - a. Type of Pruning: Cleaning Thinning Raising Reduction.
 - 3. Cut branches with sharp pruning instruments; do not break or chop.
 - 4. Do not apply pruning paint to wounds.
- B. Chip removed branches and dispose of off-site.

3.07 REGRADING

- A. Lowering Grade: Where new finish grade is indicated below existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.

- B. Lowering Grade within Protection Zone: Where new finish grade is indicated below existing grade around trees, slope grade away from trees as recommended by arborist unless otherwise indicated.
 - 1. Root Pruning: Prune tree roots exposed by lowering the grade. Do not cut main lateral roots or taproots; cut only smaller roots. Cut roots as required for root pruning.
- C. Raising Grade: Where new finish grade is indicated above existing grade around trees, slope grade beyond the protection zone. Maintain existing grades within the protection zone.
- D. Minor Fill within Protection Zone: Where existing grade is 4 inches or less below elevation of finish grade, fill with topsoil. Place topsoil in a single uncompacted layer and hand grade to required finish elevations.

3.08 FIELD QUALITY CONTROL

- A. Inspections: Engage a qualified arborist to direct plant-protection measures in the vicinity of trees, shrubs, and other vegetation indicated to remain and to prepare inspection reports.

3.09 REPAIR AND REPLACEMENT

- A. General: Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.
 - 1. Submit details of proposed root cutting and tree and shrub repairs.
 - 2. Have arborist perform the root cutting, branch pruning, and damage repair of trees and shrubs.
 - 3. Treat damaged trunks, limbs, and roots according to arborist's written instructions.
 - 4. Perform repairs within 24 hours.
 - 5. Replace vegetation that cannot be repaired and restored to full-growth status, as determined by Architect.
- B. Trees: Remove and replace trees indicated to remain that are more than 66 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Architect determines are incapable of restoring to normal growth pattern.
 - 1. Provide new trees of same size and species as those being replaced for each tree that measures 4 inches or smaller in caliper size.
 - 2. Provide one new tree(s) of 6 inch caliper size for each tree being replaced that measure more than 4 inches in caliper size.
 - a. Species: Species selected by Architect.
 - 3. Plant and maintain new trees as specified in Division 32 - Exterior Improvements, Section "Landscape Work"
- C. Soil Aeration: Where directed by Architect, aerate surface soil compacted during construction.
 - 1. Aerate 10 feet beyond drip line and no closer than 36 inches to tree trunk.
 - 2. Drill 2 inch diameter holes a minimum of 12 inches deep at 24 inches O.C.
 - 3. Backfill holes with an equal mix of native soil and sand.

3.10 DISPOSAL OF SURPLUS AND WASTE MATERIALS

- A. Disposal: Remove excess excavated material, displaced trees, trash and debris, and legally dispose of them off Owner's property.

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SANTA MARIA, CALIFORNIA

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SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

END OF SECTION

SECTION 32 11 23 AGGREGATE BASE COURSES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Paving aggregates.
- C. 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: Compacted fill under base course.
- D. Section 32 12 16 - Asphalt Paving: Finish and binder asphalt courses.
- E. Section 32 13 13 - Site Concrete: Finish concrete surface course.
- F. Section 32 18 16.13 - Playground Protective Surfacing.

1.03 REFERENCE STANDARDS

- A. AASHTO T 180 - Standard Method of Test for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop; 2022, with Errata .
- B. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)); 2012 (Reapproved 2021).
- C. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method; 2015, with Editorial Revision (2016).
- 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 (Reapproved 2021).
- E. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System); 2017, with Editorial Revision (2020).
- F. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth); 2023.
- G. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Samples: 10 lb 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. Installer's Qualification Statement.
- F. Aggregate Composition Test Reports: Results of laboratory tests on proposed and actual materials used.

G. 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 SSPWC (Greenbook). For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction.
 - 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. When aggregate materials need to be stored on site, locate where directed by District.
- C. 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. Aggregate Type Class II: Coarse or crushed aggregate, conforming to Municipality, SSPWC Section 200-2.2..
- B. Coarse Aggregate: Pit run washed stone; free of shale, clay, friable material and debris.
 - 1. Graded in accordance with ASTM D2487 Group Symbol GW.
- C. Herbicide: Comply with all applicable environmental protection and hazardous materials laws and regulations .
 - 1. Comply with current EPA acceptable standard and the California Department of Pesticide Regulations for soils sterilant.
 - 2. Comply with the "Healthy Schools Act" as amended in 2014.
 - 3. Obtain product approval from District, prior to purchase and use.
 - 4. Sterilant: Commercial grade for commercial application.
 - a. Selected as appropriate for the environment in which is it to be placed.
 - 5. Contractor shall be licensed with the State of California to apply sterilant.
 - 6. Sterilant: Commercial grade for commercial application.
 - 7. Payment for soil sterilization: Include full compensation for application and all materials and incidental work required.
 - 8. Application Rate: Follow manufacturer recommendations.

9. Acceptable Manufacturers:

- a. Dow AgroSciences; Spike 80DF: www.dowagro.com.
- b. Pro-Serve Inc.; Bare-Spot Monobor-Chlorate: www.pro-serveinc.com.
- c. Casoron 50W by Uniroyal Chemical Co., Inc.
- d. Substitutions: See Section 01 60 00 - Product Requirements.

D. Geotextile Fabric: Non-biodegradable, non-woven, placed under base;

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. Establishment of Grades

1. Set grade stakes per Section 01 70 00 - Execution and Closeout Requirements.
2. All work shall conform to the lines, elevations, and grades shown on the Drawings.
 - a. Use three consecutive points set on the same slope together so that any variation from a straight grade can be detected.
 - b. Report any such variation to the Architect. Contractor shall be responsible for any error in the grade of the finished work.
3. Grade or location stakes lost or disturbed, shall be reset by the Surveyor at no additional expense to District.
4. Areas having drainage gradients of 2 percent or more, provide elevation stakes, set with instrument, at grid intervals of 25 feet.
 - a. Intermediate stakes may be set by using a tightly-drawn string line over the tops of adjacent stakes.
 - b. Grade stakes must be set at all grade breaks, grade changes, etc.
5. Areas having drainage gradients of less than 2 percent; provide elevation stakes, set with instrument, at 10 foot intervals.
 - a. Grade stakes must be set at all grade breaks, grade changes, etc.

B. Verify that survey bench marks and intended elevations for the work are as indicated.

C. 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:
 1. Sterilize soil areas to receive paving.
 2. Apply soil sterilant in accordance with manufacturer's instructions and applicable environmental regulations.
 3. Take care to confine application to the areas to be paved. Sterilant shall not be applied within 2 feet of planting areas.
- 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 SSPWC (Greenbook), Subsection 301-2. Place aggregate base below curbs and gutters and paving also, compacted to 95 percent at vehicular traffic and 90 percent at pedestrian-only traffic.
- B. Application of Base Course:
 1. After preparing the subgrade, Avoid all vehicular or machine traffic on the subgrade.
 - a. Should it be necessary to haul over the prepared subgrade, drag and roll the traveled way as frequently as may be necessary to remove ruts, cuts, and breaks in the surface.
 - b. Rake and hand tamp all cuts, ruts, and breaks in the surface of the subgrade that are not removed by the above operations.
 - c. Equip with pneumatic tires all equipment used for transporting materials over the prepared subgrade.
 2. Do not permit continued use of sections of prepared subgrade for hauling, so as to cut up or deform it from the true cross-section. Protect the prepared subgrade from all traffic.
 3. Maintain the surface in its finished condition until the succeeding layer is placed.
- C. Under Bituminous Concrete Paving:
 1. Compact to 95 percent of maximum dry density and 90 percent at pedestrian-only traffic.
 2. It is required that areas of exterior asphalt pavement be underlain by a layer of aggregate base material which meets the requirements, Thickness of base layer is as shown on the Drawings and varies per the Usage Type area.
 - a. It is required that the upper 12 inches of soils below asphalt pavement base material be over-excavated and consist predominantly of satisfactory soil materials and/or approved imported fill.
 - 1) Engineered Fill: See Section 31 23 23 - Fill.
 - b. It is required that the exposed bottom surface soils, below overexcavation, be scarified to the recommended depth of 8 inches, moisture conditioned to achieve optimum moisture content, but not higher than 2 percent above optimum, and then re-compacted to a minimum 90 percent relative compaction before any fill materials are placed.
 3. The above subgrade preparation recommendations are based on the assumption that soils encountered during field exploration are representative of soils throughout the site.

- a. However, there can be unforeseen and unanticipated variations in soils between points of subsurface exploration. For this reason, the actual subgrade preparation will have to be determined on the basis of in-grading observations and testing performed by representatives of the project geotechnical consultant.
4. Provide grade stakes and elevations by a California Licensed Surveyor (LS) for the Geotechnical Engineer.
 - a. Verify that the over-excavation depths, shown on the construction drawings for asphalt concrete pavement structural sections, have been achieved prior to re-compaction.
5. Correct irregularities by dressing down or filling as may be required, to bring areas to true subgrade elevations.
6. Where filling is required, scarify the subgrade to bond the new material to the in place material; use additional material as required at no additional cost. Subject to the approval of the Architect.
7. Remove excess material from the site to a legal disposal area.
- D. Under Portland Cement Concrete Paving:
 1. Compact to 95 percent of maximum dry density and 90 percent at pedestrian-only traffic.
- E. Place aggregate in maximum 4 inch layers and roller compact to specified density.
- F. Level and contour surfaces to elevations and gradients indicated.
- G. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
- H. Add water to assist compaction. If excess water is apparent, remove aggregate and aerate to reduce moisture content.
- I. Use mechanical tamping equipment in areas inaccessible to compaction equipment.
- J. Apply herbicide to finished surface.

3.04 TOLERANCES

- A. Subgrade Tolerances:
 1. Subgrade for Pavement: Do not vary more than 0.02 ft..
 2. Subgrade for Subbase or Base Material: Do not vary more than 0.04 ft..
 3. Variations within the above specified tolerances shall be compensating so that the average grade and cross section specified are met.
- B. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- C. Scheduled Compacted Thickness: Within 1/4 inch.
- D. Variation From Design Elevation: Within 1/2 inch.

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 AASHTO T 180, ASTM D698 ("standard Proctor"), or 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

SECTION 32 12 16 ASPHALT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Aggregate base course.
- B. Single course bituminous concrete paving.
- C. Double course bituminous concrete paving.
- D. Surface sealer.
- E. This section compliments and shall be coordinated with Civil Drawing specifications / requirements. The most stringent requirements shall be utilized.
- F. Asphaltic concrete paving for vehicular traffic and curbs, including necessary patching and repair of damaged new and existing paving.
- G. Patching and repair of existing asphaltic concrete paving for previous damage, for underground utility work and where damaged by new construction.
 - 1. Bituminous Surfacing Repair: Areas removed for utility trenches, heaved by tree roots, cracked areas, protruding areas where pavement meets hard surfaces, depressed areas, holes and areas around new structures, and raveled bituminous pavement.
 - 2. Areas heaved by tree roots, cracked areas, holes, and trenches.

1.02 RELATED REQUIREMENTS

- A. Section 02 41 00 - Demolition: Selective demolition, site demolition, structure removal.

1.03 REFERENCE STANDARDS

- A. AASHTO T 283 - Standard Method of Test for Resistance of Compacted Asphalt Mixtures to Moisture-Induced Damage; 2021.
- B. AASHTO T 324 - Standard Method of Test for Hamburg Wheel-Track Testing of Compacted Asphalt Mixtures; 2019.
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- D. AI MS-2 - Asphalt Mix Design Methods; 2015.
- E. AI MS-19 - Basic Asphalt Emulsion Manual; 2008.
- F. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- G. ASTM C117 - Standard Test Method for Materials Finer than 75- μ m (No. 200) Sieve in Mineral Aggregates by Washing; 2017.
- H. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates; 2019.
- I. ASTM D5261 - Standard Test Method for Measuring Mass per Unit Area of Geotextiles; 2010 (Reapproved 2018).
- J. ASTM D6140 - Standard Test Method to Determine Asphalt Retention of Paving Fabrics Used in Asphalt Paving for Full-Width Applications; 2000(2014).
- K. CBC - California Building Code; Current Adopted Edition.
- L. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.

- M. ASTM D4632/D4632M - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles; 2015a (Reapproved 2023).
- N. ASTM D5035 - Standard Test Method for Breaking Force and Elongation of Textile Fabrics (Strip Method); 2011(Reapproved 2015).
- O. ASTM D5199 - Standard Test Method for Measuring the Nominal Thickness of Geosynthetics; 2012 (Reapproved 2019).
- P. ASTM D4533/D4533M - Standard Test Method for Trapezoid Tearing Strength of Geotextiles; 2015 (Reapproved 2023).
- Q. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction; 2009a.
- R. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.

1.04 SUBMITTALS

- A. Materials List: List source and quality standard for all asphaltic concrete materials.
- B. Mix Design:
 - 1. Formulate a job-mix formula using the Hveem method in accordance with SSPWC (Greenbook) Section 203-6.2 and submit for approval.
 - 2. 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.
 - 3. Resultant Mixture: Hveem properties conforming to SSPWC (Greenbook) Section 203-6.4.4.
- C. Certifications:
 - 1. Weighmaster's Certificates or certified delivery tickets for each truckload of bituminous material delivered to site.
 - 2. Certificates of Conformance: Asphalt, aggregate and sterilant materials.
 - a. 20 days prior to the delivery of aggregates, asphalt materials, and paving mixes to the project site, submit certificates and test results of compliance of such materials with these specifications.
 - b. Submit certificates of compliance from the supplier for bituminous materials for paint binder, asphaltic concrete, and seal coat.
 - c. Submit weigh master's certificates or certified delivery tickets for each truck load of asphaltic material delivered to the project site.
 - d. Upon completion of the weed control treatment, and as a condition for final acceptance, furnish a written certificate stating the brand name of the sterilant and the manufacturer, and that the sterilant used had at least the minimum required concentration, and that the rate and method of application complied in every respect with the conditions and standards contained herein.
- D. Samples:
 - 1. Prior to the delivery of specified aggregate to the site, submit samples of the material for the Inspector's acceptance in accordance with SSPWC (Greenbook) Section 4-1.4. Samples shall be typical of materials to be furnished from the proposed source and in conformance with the specified requirements.
 - 2. Provide aggregate base gradation and quality certifications, dated within 30 days of submittal.

1.05 QUALITY ASSURANCE

- A. Perform Work in accordance with locally adopted {\rs\#1}.
- B. Mixing Plant: Conform to Locally adopted SSPWC (Greenbook).
 - 1. Asphaltic Concrete Producers Qualifications: Use only materials furnished by a bulk asphaltic concrete producer regularly engaged in production of hot mix, hot laid bituminous concrete.
 - 2. Applicator Qualifications: Paving machine and roller operators shall be fully trained and experienced in the installation of asphaltic concrete paving on projects of similar size and complexity.
- C. Testing and analysis of granular base material and asphaltic concrete paving mix shall be performed under provisions of Division 01.
- D. Obtain materials from same source throughout.

1.06 FIELD CONDITIONS

- A. Do not place asphalt when ambient air or base surface temperature is less than 40 degrees F, or surface is wet or frozen; or when rain is imminent.
 - 1. Tack Coats: Minimum surface temperature of 60 deg F.
 - 2. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
 - 3. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
- B. Place bitumen mixture when temperature is not more than 15 F degrees below bitumen supplier's bill of lading and not more than maximum specified temperature.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable code for paving work on public property.
- B. Where reference is made to SSPWC (Greenbook), the following shall apply.
 - 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 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, seal coat, tack coat, primer, and other materials shall not exceed limits permitted under current regulations of local Air Quality Management District (AQMD).
- D. Conform to California Code of Regulations (CCR), Volume 2, Part 2, Chapters 18A and 19A.
- E. Conform to California Building Code (CBC), Chapter 11B and ADA Standards for accessibility requirements.
 - 1. Paving shall be stable, firm, and slip resistant and shall comply with CBC Ch. 11B-302 and 11B-403.
 - 2. Paving 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 Ch. 11B-403.2.

3. Accessible routes of travel, walks, paving, and sidewalks, shall have a continuous common surface with minimum width of 48 inches per CBC Ch. 11B-403.5.1, not interrupted by steps or by abrupt changes in level.
 - a. CBC Ch. 11B-303.2 Vertical: Changes in level exceeding 1/4 inch high maximum shall be permitted to be vertical and without edge treatment.
 - b. CBC Ch. 11B-303.3 Beveled: Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.
4. Surface cross slopes shall not exceed 2 percent on any accessible path of travel.

2.02 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. Asphalt Concrete Materials: SSPWC (Greenbook), Subsection 203-6.
- D. Aggregate for Base Course: See Section 32 11 23 - Aggregate Base Course.
- 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. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.
- G. Fiber Reinforcement: Synthetic fibers shown to have long-term resistance to deterioration when in contact with alkalis and moisture; 1/2 inch length.
- H. Geotextile Fabric: Non-biodegradable, non-woven Petromat Enviro manufactured by Propex Operating Company, LLC.
 1. Geotextile Construction: Needle-punched nonwoven geotextile composed of 100% polypropylene or polypropylene / recycled polyester blend, staple fiber and heat calendered on one side.
- I. Crack Filler:
 1. Cracks less than 1/2 inch in width: GuardTop Crackfiller or equal.
 2. Cracks 1/2 inch or greater in width: #4 Sheet mix asphalt.
- J. Primer: In accordance with locally adopted {rs#1}.
- K. Tack Coat: Homogeneous, medium curing, liquid asphalt.
- L. Seal Coat: AI MS-19, slurry type.
 1. Asphalt Emulsion, www.aema.org, SS1-h, per SSPWC (Greenbook) Section 203-9.
 2. Acceptable Manufacturers:
 - a. Blue Diamond Asphalt; Satin Seal: www.bluediamondasphalt.com.
 - b. Diversified Asphalt Product; Over Kote: www.diversifiedasphalt.com.
 - c. Gold Star Asphalt Products: goldstarsphalt.com
 - d. SealMaster Pavement Products & Equipment; MasterSeal: sealmaster.net.
 - e. Vulcan Materials Company; GuardTop: www.vulcanmaterials.com.
 - f. Western Colloid Products; Park Top: www.westerncolloid.com.
 - g. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 GEOTEXTILE INTERLAYER FOR BITUMINOUS PAVEMENT OVERLAYS

- A. Geotextile Fabric: Non-biodegradable, non-woven manufactured by Propex Operating Company, LLC., or equal.
- B. The geotextile construction shall be a needle-punched nonwoven geotextile composed of 100% polypropylene or polypropylene / recycled polyester blend, staple fiber and heat calendered on one side.
- C. Geotextile Property Values:

Mass Per Unit Area (1) ASTM D5261	153 (4.5) g/m2 (oz/yd2)
Asphalt Retention (4) ASTM D6140	0.9 (0.20)l/m2 (gal/yd2)
Grab Tensile Strength (2) (MD, CMD, 45 bias) ASTM D4632/D4632M	400 (90)N (lbs)
Grab Elongation (2) (MD, CMD, 45 bias) ASTM D4632/D4632M	> 25 Percent
Strip Tensile Strength (1) (MD, CMD, 45 bias) ASTM D5035	200 (45) N (lbs)
Strip Elongation (1) (MD, CMD, 45 bias) ASTM D5035	> 25 Percent
Asphalt Saturated Grab Tensile Strength (4) (MD, CMD, 45 bias) ASTM D6140, ASTM D4632/D4632M	1023 (230) N (lbs)
Asphalt Saturated Grab Elongation (4) (MD, CMD, 45 bias) ASTM D6140, ASTM D4632/D4632M	> 25 Percent
Thickness (1) ASTM D5199	0.89 (35) mm (mils)
Asphalt Saturated Thickness (4) ASTM D6140, ASTM D5199	1.78 (70) mm (mils)
Melting Point (2) ASTM A276/A276M	160 (320) Degrees C (F)
Solar Reflectance Temperature Reduction, Measured	10 (50) Degrees C (F)
Trapezoidal Tear Strength (2) ASTM D4533/D4533M	< 45 lbs
Asphalt Saturated Trapezoidal Tear Strength (3), ASTM D6140, ASTM D4533/D4533M	< 25 lbs
Milled Enviro RAP Particle Size Distribution (5)	ASTM C117 100 % passing 1.0"ASTM C136/C136M 95% passing 0.75"
Dry Tensile Strength (6), AASHTO T 283: Recycled Pavement Enhancement with 30% Enviro RAP	psi
TSR – Tensile Strength Ratio, AASHTO T 283	> 200 %
Maximum Rut Depth at 20,000 passes (6) AASHTO T 324	> 0.9 mm
Asphalt Stripping at 20,000 passes (6) AASHTO T 324	<2.9

Flexibility Index with Enviro RAP (6), I-FIT6	None >4.5
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- (1) Minimum Average Roll Value (MARV) values shown represent weaker principal direction.*
- (2) Typical (Average) values shown represent weaker principal direction.*
- (3) Maximum Test Value (MaxTV) per ASTM D8102 performed annually by third party testing.*
- (4) Minimum Test Value (MinTV) per ASTM D8102 performed annually by third party testing.*
- (5) Field evaluation and testing by NCAT (National Center for Asphalt Technology) or an independent third party approved by project engineer.*
- (6) I-FIT - Illinois Flexibility Index Test*

2.04 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Asphalt Surfacing Materials: Provide asphalt surfacing meeting the following requirement, furnished from a commercial asphalt central mixing plant.
- B. Use dry material to avoid foaming. Mix uniformly.
- C. Base Course: 4.5 to 5.8 percent of asphalt cement by weight in mixture in accordance with SSPWC (Greenbook) Section 203-6.4.4, Type B.
- D. Binder Course: 4.5 to 6 percent of asphalt cement by weight in mixture in accordance with AI MS-2.
 - 1. CSS-1 h and conform to the requirements of SSPWC (Greenbook), Section 203-3 Emulsified Asphalt.
- E. Parking Lot Wearing Course: 4.6 to 6.0 percent of asphalt cement by weight in mixture in accordance with Section 203-6.4.3, Type C2.
 - 1. Provide at least two courses of asphalt when Type C2 asphalt pavement is greater than 3 inches.
 - 2. Surface Course Minimum Thickness: 1 inch and a maximum of 2 inches.
- F. Submit proposed mix design of each class of mix for review prior to beginning of work.

2.05 SOURCE QUALITY CONTROL

- A. Test mix design and samples in accordance with AI MS-2.
- B. Submit asphaltic concrete mix design proposed by the Contractor to the Engineer for review.
- C. Proposed mix to be tested for conformance with the specifications, including grading, asphalt content and stability.

2.06 ACCESSORIES

- A. Headers and Stakes:
 - 1. 2 x 6 inch nominal Redwood, Construction Heart Grade, or preservative treated Douglas Fir (PTDF), except at curves provide laminated 1 x 6 inch nominal PTDF, unless indicated otherwise on Drawings
 - 2. Stakes: 2 x 4 x 18 inch long Redwood, or 2 x 3 x 18 inch long PTDF; at 48 inch on center maximum.
 - 3. Nails: Common, use hot dipped galvanized only, 12d minimum.

- B. Pavement Reinforcing Fabric: Non-woven polypropylene fabric conforming to SSPWC (Greenbook), Subsection 213-1.
 - 1. Basis of Design Product: Petromat as manufactured by Propex Fabrics inc.; www.geotextile.com, or approved equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that compacted subgrade and granular base is dry and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.
- C. Fine grading, checking, shaping, and compacting of subgrade shall be complete before start of asphaltic concrete Work.
- D. 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.
- E. 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.
- F. Headers: Place headers with tops flush with finish asphaltic concrete surfaces. Back headers with stakes.
 - 1. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
 - 2. Install headers so the bottom surface has continuous bearing on solid grade. Where excavation for headers is undercut, thoroughly tamp soil under the header. Compact backfill on both sides of header to the density of adjacent undisturbed earth.
 - 3. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid grade a minimum of 12 inches. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header. Provide a minimum of 2-12d galvanized common nails through each stake.
 - 4. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
 - 5. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
 - 6. Provide additional stakes and anchorage as required to fasten headers in place
- G. Do not asphalt concrete on any surface, which contains ponded water or excessive moisture in the opinion of the Architect or consulting engineer.
 - 1. If paving operations are in progress and rain or fog forces a shut down, loaded trucks in transit shall return to the plant, and no compensation will be allowed therefore.
 - 2. Provide canvas tarpaulins to cover all loads of asphalt from the time that the mixture is loaded until it is discharged from the delivery vehicle, unless otherwise directed in writing.

3.02 PAVEMENT REPAIR REMOVAL

- A. Remove bituminous and concrete pavement in accordance with applicable provisions of SSPWC (Greenbook) Section 300 - Earthwork.

- B. Pavement Heaved By Roots:
 - 1. Remove pavement to limits of distortion and expose roots.
 - 2. Trim roots to provide at least 12 inch clearance to pavement.
- C. Remove protruding bituminous surfaces flush with the surrounding grade using a suitable tool or equipment so that adjacent finishes are not blackened.
- D. Remove raveled and depressed bituminous pavement to limits indicated or required.
- E. Saw cut existing improvements, trim holes and trenches in bituminous and concrete pavement to permit mechanical hand tampers to compact the fill.
- F. Remove broken concrete by saw cutting. If the required cut line is within 30 inches of a score or joint line or edge, cut and remove to the score, joint line, or edge.

3.03 EXCAVATING, BACKFILLING AND COMPACTING FOR REPAIR

- A. Conform to requirements in Section 31 23 16.13 - Trenching, as required.
- B. Where subgrade or base is deemed to be unstable or otherwise unsuitable, excavate such materials to firm earth, and replace with a required material. Install and compact fill materials in accordance with the requirements of related Specification sections.

3.04 HEADERS

- A. Install headers along edge of bituminous surfacing abutting turf, earth, or planting area, unless indicated otherwise.
- B. Install headers so the bottom surface has continuous bearing on solid grade.
 - 1. Where excavation for headers is undercut, thoroughly tamp soil under the header.
 - 2. Compact backfill on both sides of header to the density of the adjacent undisturbed grade.
- C. Fasten headers in place with redwood or Douglas fir stakes of length necessary to extend into solid earth a minimum of 12 inches.
 - 1. Stakes shall be of sound material, neatly pointed, driven vertically, and securely nailed to headers.
 - 2. Space stakes, not to exceed 4 feet on centers with top of stakes set one inch below top of header.
 - 3. Provide a minimum of two 12d galvanized common nails through each stake.
- D. Remove existing headers where new surfacing is installed adjacent to existing surfacing.
- E. Install temporary headers at transverse joints of paving where continuous paving operations are not maintained.
- F. Provide additional stakes and devices as required to fasten headers.

3.05 RESURFACING

- A. Holes and Trenches:
 - 1. Remove loose dirt and backfill with cement-sand slurry allowing for surfacing one inch thicker than existing.
 - 2. Resurface flush with existing adjoining pavement installing the same type of materials and section provided in existing improvements.
- B. Other Areas:
 - 1. Other surface improvements damaged or removed shall be cut to a neat even line and excavated one inch below the bottom of the existing pavement.

2. Resurface by following the original grades and installing the same type of materials provided in existing improvements.
- C. Where bituminous surfacing abuts concrete, masonry, walks or paving, tamp joint smooth, if necessary, as described above to obtain a uniformly even joint, true to line and grade. Tamp and smooth materials before asphalt cools.

3.06 AGGREGATE BASE COURSE

- A. Place and compact aggregate base course.
- B. Unless otherwise indicated, base course shall be crushed aggregate base, fine grade, 3 inches thick or equal to thickness of the existing base, whichever is greater.
- C. Inspector will examine the base before the paving has begun. Correct any deficiencies before the paving is started.
- D. Wherever asphaltic pavement does not terminate against a curb, gutter, or another pavement, provide and install a redwood or pressure treated Douglas fir header at the line of termination.

3.07 PREPARATION - PRIMER

- A. Apply primer in accordance with manufacturer's instructions.
- B. Apply primer on aggregate base or subbase at uniform rate of 0.25 gal/sq yd.
- C. Apply primer to contact surfaces of curbs, gutters.
- D. Use clean sand to blot excess primer.

3.08 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with SSPWC (Greenbook) Section 302-5.4.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.10 gal/sq yd.
- C. Apply tack coat to contact surfaces of curbs, gutters and previously placed or existing paving.
- D. Joining Pavement: Expose, cut and clean edges of existing pavement to straight, vertical surfaces for full depth of existing pavement.
 1. Paint edge with asphalt emulsion before placing new asphaltic concrete.
 2. Joints in New Paving: In accordance with SSPWC (Greenbook).

3.09 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install Work in accordance with Subsection 302-5.
- B. Asphalt concrete of the class indicated in Part 2 shall be laid in courses conforming to SSPWC (Greenbook) Table 302-5.5(A), unless otherwise stated herein.
- C. Place asphalt within 24 hours of applying primer or tack coat.
- D. Place thickness as indicated on Civil Drawings to minimum 1 inch compacted thickness.
 1. Asphalt concrete work shall include full depth patching and variable thick asphalt concrete transition areas.
 2. Provide daily the Inspector, with copies of certificates of weight for all materials delivered to the job site and/or incorporated in the work.
 3. At no time shall the coarse aggregate that has segregated from the mix be scattered across the paved mat.
- E. Install gutter drainage grilles and frames and manhole frames in correct position and elevation.

- F. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with SSPWC (Greenbook), Subsection 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.
 - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- G. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.10 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Provide at least two courses of asphalt when Type D2 asphalt pavement is greater than 1-1/2 inches. The surface course shall be a minimum thickness of 1 inch and a maximum of 1-1/2 inches.
- B. Provide at least two courses of asphalt when Type C2 asphalt pavement is greater than 3 inches. The surface course shall be a minimum thickness of 1 inch and a maximum of 2 inches.
- C. Install Work in accordance with SSPWC (Greenbook) Subsection 302-5.
- D. Place asphalt binder course within 24 hours of applying primer or tack coat.
- E. Place binder course to thickness as indicated on Civil Drawings, minimum 1 inch compacted thickness.
- F. Place asphalt wearing course within two hours of placing and compacting binder course.
- G. Place wearing course to thickness as indicated on Civil Drawings, minimum 1 inch compacted thickness.
- H. Install gutter drainage grilles and frames and manhole frames in correct position and elevation.
- I. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position.
 - 1. Compact (roll) asphaltic concrete in accordance with SSPWC (Greenbook), Subsection 302-5.6, using machine rollers.
 - a. Compaction by vehicular traffic is prohibited.
 - b. Compact areas inaccessible to rolling equipment with machine-powered tamper.
- J. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.11 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 § 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.

3.12 PAVEMENT REPAIR AND PAVING

- A. Preparation of existing pavement: Where indicated, remove loose asphaltic concrete, cleanout "pot holes" 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 wide with asphalt emulsion slurry.
- C. Repair of Existing Surfacing:
 - 1. Fill cracks 1/2 inch wide and less with RS-1 emulsion and silica sand or other required material.
 - 2. Cracks larger than 1/2 inch wide shall be filled with Type C2 Asphalt Concrete as specified.
 - a. Cracks shall be filled to the level of adjacent surfacing.
 - 3. Where low areas, holes, or depressions occur in existing surfacing, repair with emulsified asphalt.
 - a. Install material, strike off the emulsified asphalt with a straightedge flush with adjoining surfacing.
 - b. Finish with a steel trowel, and after dehydration, compact by rolling or tamping.
- D. 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.
- E. Fabric Reinforcement: Place fabric smooth side up in tack coat with 2 to 4 inch overlap. Hand-broom to remove wrinkles. Apply addition tack coat to joints and between overlapped fabric layers.
- F. Overlay Asphalt: Place single course asphalt, 1-1/2 inch compacted thickness, in conformance with specified standards in this section.

3.13 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Compacted Thickness: Within 1/4 inch of specified or indicated thickness.
- C. Variation from True Elevation: Within 1/2 inch.

3.14 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.
 - 1. Flood test entire area in presence of the Project Inspector.
 - 2. Test entire area to verify it is free of standing water or puddles.
- C. Pavement at all longitudinal joints shall have a Field Density of 95%, as described in SSPWC (Greenbook), Section 302-5.6.2.
 - 1. When the test results of the field cores are less than 95% Relative Compaction, remove a 1 foot wide section on each side of the longitudinal joint.
 - 2. Replace the removed pavement with an asphalt mix that meets the job specification at no additional cost to the District.
- D. Test: Flood test all paving to demonstrate positive drainage.

1. Before acceptance, water test all pavements to ensure proper drainage as directed by the Inspector.
2. Flooding Method: By water tank truck.
3. Fill depressions where the water ponds to a depth of more than 1/8 inch; or the slope corrected to provide proper drainage.
4. The edges of the fill shall be feathered and smoothed so that the joint between the fill and the original surface is invisible.
5. No standing water shall remain 1-hour after test.

3.15 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 2 days or until surface temperature is less than 140 degrees F.
 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.

3.16 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

SECTION 32 13 13 SITE CONCRETE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Concrete area paving, sidewalks, stair steps, integral curbs, gutters, parking areas, cast-in-place walls, and general site applications.

1.02 RELATED REQUIREMENTS

- A. Section 03 10 00 - Concrete Forming and Accessories.
- B. Section 07 92 00 - Joint Sealants: Sealing joints.
- C. Section 31 22 00 - Grading: Preparation of site for paving.
- D. Section 31 23 23 - Fill: Compacted subbase for paving.
- E. Section 32 11 23 - Aggregate Base Courses: Gravel base course.
- F. Section 32 17 13 - Concrete Wheel Stops: Precast concrete parking bumpers.
- G. Section 32 17 23 - Pavement Markings.
- H. Section 32 17 26 - Tactile Warning Surfacing: Plastic tactile and detectable warning tiles for pedestrian walking surfaces.

1.03 REFERENCE STANDARDS

- A. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- B. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- C. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- D. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- E. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- F. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- G. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- H. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- I. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2019.
- J. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- K. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2023.
- L. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- M. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- N. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2019.
- O. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2019, with Editorial Revision (2022).

- P. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Asphalt Types); 2023.
- Q. ASTM D1752 - Standard Specification for Preformed Sponge Rubber, Cork, and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction; 2018 (Reapproved 2023).
- R. CBC - California Building Code; Current Adopted Edition.
- S. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- T. CBC Chapter 11B - California Building Code-Chapter 11B; Current adopted edition.
- U. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on joint filler, admixtures, and curing compound.

1.05 QUALITY ASSURANCE

- A. 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.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.

PART 2 PRODUCTS

2.01 PAVING ASSEMBLIES

- A. Comply with applicable requirements of ACI SPEC-301.
- B. Concrete Sidewalks: 4,000 psi 28 day concrete, thickness as indicated on Drawings, minimum 4 inches, natural grey color Portland cement.
- C. Site Concrete: 4,000 psi 28 day concrete, thickness as indicated on Drawings, minimum 4 inches, natural grey color Portland cement.

2.02 REGULATORY REQUIREMENTS

- A. Conform to California Code of Regulations (CCR), Volume 2, Part 2, Chapters 18A and 19A.
- B. Conform to California Building Code (CBC), CBC Chapter 11B and ADA Standards for accessibility requirements.
 - 1. Portland cement concrete paving shall be stable, firm, and slip resistant and shall comply with CBC Section 11B-302 and 11B-403.
 - 2. 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 Section 11B-403.2.
 - 3. Accessible routes of travel, walks, paving, and sidewalks, shall have a continuous common surface with minimum width of 48 inches per CBC Section 11B-403.5.1, not interrupted by steps or by abrupt changes in level.
 - a. CBC Section 11B-303.2 Vertical: Changes in level exceeding 1/4 inch high maximum shall be permitted to be vertical and without edge treatment.
 - b. CBC Section 11B-303.3 Beveled: Changes in level between 1/4 inch high minimum and 1/2 inch high maximum shall be beveled with a slope not steeper than 1:2.

4. Surface cross slopes shall not exceed 2 percent on any accessible path of travel.
- C. Albedo Reflectance of Finish Concrete: 0.30, minimum.
- D. Treads, Risers, and Nosings: CBC Section 11B-504
 1. Exterior stairs shall have the upper approach and all treads marked by a stripe providing clear visual contrast.
 2. The stripe providing clear visual contrast shall be a minimum of 2 inches wide to a maximum of 4 inches wide placed parallel to, and not more than 1 inch from, the nose of the step or upper approach. The stripe shall extend the full width of the step or upper approach and shall be of material that is at least as slip resistant as the other treads of the stair. A painted stripe shall be acceptable. Grooves shall not be used to satisfy this requirement.
 3. The radius of curvature at the leading edge of the tread shall be no greater than 1/2 inch. Nosings that project beyond risers shall have the underside of the leading edge curved or beveled. The maximum angle for a riser to slope under the tread shall be 30 degrees from vertical. Nosings shall extend 1-1/4 inch maximum over the tread below.
 4. Treads shall be 11 inches deep minimum. Risers shall be 7 inches high maximum and 4 inches high minimum. All steps on a flight of stairs shall have uniform riser heights and uniform tread depths. Open risers are not permitted .

2.03 FORM MATERIALS

- A. Form Materials: As specified in Section 03 10 00, comply with ACI SPEC-301.
- B. Joint Filler: Preformed; non-extruding bituminous type (ASTM D1751) or sponge rubber or cork (ASTM D1752).
 1. Thickness: 1/2 inch.
 2. Product:

2.04 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 (60,000 psi) yield strength; deformed billet steel bars; unfinished.
- B. Dowels: ASTM A615/A615M, Grade 60 - 60,000 psi yield strength; deformed billet steel bars; unfinished finish.
- C. Provide supports for reinforcement to position the bars at mid depth of the concrete. Plastic and/or steel chairs, and dobies are acceptable.

2.05 CONCRETE MATERIALS

- A. Obtain cementitious materials from same source throughout.
- B. Cement: ASTM C150/C150M, Sulfate Resistant - Type V Portland cement, gray color.
- C. Fine and Coarse Mix Aggregates: ASTM C33/C33M.
- D. Water: Clean, and not detrimental to concrete.
- E. Chemical Admixtures: ASTM C494/C494M, Type A - Water Reducing, Type C - Accelerating, 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. Curing Compound: ASTM C309, Type 1-D, Class A.

1. Comply with all applicable air pollution requirements.
- B. Liquid Surface Sealer: <>
 1. Penetrating High solids, acrylic curing and sealing compound: Minimum 25% non-yellowing, acrylic solids curing compound; shall conform to ASTM C309 and/or ASTM C1315, Type I, Class A, VOC compliant.
 - a. Products:
 - 1) Laticrete International, Inc.; L&M Aquapel Plus: www.lmcc.com.
 - 2) L.M. Scofield Company (Sika Brand); Cureseal-W: www.scofield.com.
 - 3) W. R. Meadows Company; Intraguard: www.wrmeadows.com.
 - 4) Substitutions: See Section 01 6000 - Product Requirements.
- C. Slab Isolation Joint Filler: 1/2 inch thick, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 1. Material: Closed-cell, non-absorbent, compressible polymer foam in sheet form.
- D. Tactile Warning Surfaces: See Section 32 17 26.

2.07 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
- B. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI SPEC-301.
 1. For trial mixtures method, employ independent testing agency acceptable to Architect for preparing and reporting proposed mix designs.
- C. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended by manufacturer.
- D. Concrete Properties:
 1. Compressive strength, when tested in accordance with ASTM C39/C39M at 28 days; As scheduled.
 2. Water-Cement Ratio: Maximum 40 percent by weight, or according to indicated concrete strength..
 3. Maximum Slump: 4 inches.

2.08 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify compacted subgrade is acceptable and ready to support paving and imposed loads.
- B. Verify gradients and elevations of base are correct.

3.02 SUBBASE

- A. See Section 32 11 23 for construction of base course for work of this Section, where indicated on Drawings.

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.
- B. Moisten base to minimize absorption of water from fresh concrete.
- C. Notify Architect minimum 24 hours prior to commencement of concreting operations.

3.04 COORDINATION WITH EXISTING CONSTRUCTION

- A. Connection to Existing Construction: Where new concrete is doveled to existing construction, drill holes in existing concrete, insert steel dowels and pack with non-shrinking grout.
- B. Preparation of Existing Concrete: Prepare previously placed concrete by cleaning with steel brush and apply bonding agent in accordance with manufacturer's instructions.

3.05 FORMING

- A. Place and secure forms to correct location, dimension, profile, and gradient.
- B. Assemble formwork to permit easy stripping and dismantling without damaging concrete.
- C. Place joint filler vertical in position, in straight lines. Secure to formwork during concrete placement.

3.06 REINFORCEMENT

- A. Place reinforcement at midheight of slabs-on-grade.
 1. Locate reinforcement to provide required cover by concrete. If not otherwise indicated on Drawings, provide concrete cover in compliance with ACI 318.
 2. 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 nor less than 1-1/3 times maximum size aggregate.
 3. Reinforcement Supports: Provide load bearing pads under supports or provide precast concrete block bar supports.
- B. Interrupt reinforcement at contraction and expansion joints.
- C. Place dowels to achieve pavement and curb alignment as detailed.
 1. Secure tie dowels in place before depositing concrete.
 2. Provide No. 3 bars, 18 inch long at 24 inches O.C. for securing dowels where no other reinforcement is provided.

3.07 COLD AND HOT WEATHER CONCRETING

- A. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- B. Follow recommendations of ACI PRC-306 when concreting during cold weather.
- C. Do not place concrete when base surface temperature is less than 40 degrees F, or surface is wet or frozen.

3.08 PLACING CONCRETE

- A. Place concrete in accordance with ACI PRC-304.
 1. Mixing: If batch plant is within travel time not exceeding maximum limits, transit mix concrete in accordance with ASTM C94/C94M. If travel time exceeds limits, provide alternative means for mixing and submit for review and approval.
- B. Do not place concrete when base surface is wet.

- C. Ensure reinforcement, inserts, embedded parts, formed joints are not disturbed during concrete placement.
- D. 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.
- E. Place concrete to pattern indicated.

3.09 JOINTS

- A. Align curb, gutter, and sidewalk joints.
- B. Place 1/2 inch wide expansion joints at 20 foot intervals and to separate paving from vertical surfaces and other components and in pattern indicated.
 - 1. Form joints with joint filler extending from bottom of pavement to within 1/2 inch of finished surface.
 - 2. Secure to resist movement by wet concrete.
 - 3. If expansion joints are not indicated, conform to SSPWC (Greenbook) and standard details and specifications of authorities having jurisdiction.
- C. Provide scored joints.
 - 1. Tooled Joints: 1-inch deep by 3/16-inch wide tooled joints with 1/8-inch radius corners.
 - 2. At 5 feet intervals for pedestrian paving.
 - 3. At 10 feet intervals for vehicle paving.
 - 4. Between sidewalks and curbs.
 - 5. Between curbs and pavement.
- D. Provide keyed joints as indicated.
- E. Saw cut contraction joints 3/16 inch wide at an optimum time after finishing. Cut 1/3 into depth of slab.

3.10 FINISHING

- A. Area Paving: Light broom, texture perpendicular to pavement direction.
- B. Sidewalk Paving: Medium broom, texture perpendicular to pavement direction with troweled and radiused edge.
- C. Curbs and Gutters: Light broom, texture parallel to pavement direction.
- D. Place sealer on exposed concrete surfaces immediately after finishing. Apply in accordance with manufacturer's instructions.

3.11 TOLERANCES

- A. ACI 301, Class B, except paving in public rights-of-way shall conform to SSPWC (Greenbook).
- B. Maximum Variation of Surface Flatness: 1/4 inch in 10 ft.
- C. Maximum Variation From True Position: 1/4 inch.
- D. Control-joint grooves and other conspicuous lines:
 - 1. 1/4 inch maximum in any 20 feet.
 - 2. 1/2 inch maximum in any 40 feet.
- E. Variation in Cross-Sectional Thickness of Slabs:
 - 1. Minus 1/4 inch.

2. Plus 1/2 inch.

F. Variation in Radii

1. In radii of less than 10 feet:
 - a. 1/8 inch in any 5 feet.
 - b. 1/4 inch in any 10 feet.
2. In radii of 20 feet:
 - a. 1/4 inch in any 10 feet.
 - b. 3/8 inch in any 20 feet
3. In radii of 30 feet or more:
 - a. 1/2 inch in any 20 feet.
 - b. 1 inch in any 30 feet.

G. Coefficient of Friction for Finish Surface:

1. Pedestrian Vehicular Finish Surface: Minimum 0.6 static coefficient of friction is required for all concrete paving finish surface. All concrete paving surfaces to be broom finish.
2. Ramps: Minimum 0.8 static coefficient of friction is required for all concrete paving finish surfaces on ramps. All concrete paving surfaces on ramps to be broom finish.

3.12 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 40 00 - Quality Requirements.
 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 compliance with specified requirements.
- B. Compressive Strength Tests: ASTM C39/C39M; for each test, mold and cure three concrete test cylinders. Obtain test samples for every 75 cu yd or less of each class of concrete placed.
 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.

3.13 PROTECTION

- A. Immediately after placement, protect pavement from premature drying, excessive hot or cold temperatures, and mechanical injury.
 1. Provide lumber ramping and plywood covering where curbs and gutters are subject to vehicular and equipment traffic during construction.

END OF SECTION

SECTION 32 14 13 PRECAST CONCRETE UNIT PAVING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Non-interlocking concrete paver units and detectable warning pavers.
- B. Detectable warning pavers.
- C. Edge restraints.

1.02 RELATED REQUIREMENTS

- A. Section 32 13 13 - Site Concrete: Concrete subbase for pavers.

1.03 REFERENCE STANDARDS

- A. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide characteristics of paver unit, detectable warning pavers, dimensions, and special shapes.
- C. Product Data: Provide characteristics of polymeric sand, including base material, additive(s), compressive strength, and color.
- D. Samples: Submit two samples of each paver type, illustrating style, size, color range and surface texture of units being provided.
- E. Manufacturer's Installation Instructions: Indicate substrate requirements and installation methods.
- F. Maintenance Materials: Provide the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.
 - 2. Extra Pavers: 10 of each type and size.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Non-interlocking Concrete Pavers:
 - 1. Oldcastle: www.oldcastle.com/#sle.
 - 2. Orco Pavingstones: orcopaverwalls.com.
 - 3. Stepstone Inc: www.stepstoneinc.com.
 - 4. Tectura Designs, a division of Wausau Tile Inc: www.tecturadesigns.com/#sle.
 - 5. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.02 MATERIALS

- A. Non-interlocking Pavers: Precast concrete.
 - 1. Compressive Strength: Minimum of 7200 pounds per square inch.

2. Absorption: 5 percent average, with maximum of 7 percent.
 3. Air Entrainment: 5 to 7 percent.
 4. Size: 12 by 12 inches.
 5. Thickness: 2 inches.
 6. Color: Selected from manufacturer's full range.
- B. Detectable Warning Pavers: Cast concrete with truncated domes, yellow color.
- C. Edging: Concrete curb, as detailed.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that substrate is level or to correct gradient, smooth, capable of supporting pavers and imposed loads, and ready to receive work of this Section.
- B. Verify gradients and elevations of substrate are correct.
- C. Verify dry weather forecast without rain for a minimum of 24 hours with temperatures above 55 degrees Fahrenheit.

3.02 PREPARATION

- A. Treat soil with herbicide to retard plant growth.
- B. See Section 32 13 13 for concrete subbase.

3.03 INSTALLATION OF SOLID PAVER UNITS

- A. Spread sand bedding evenly over prepared substrate surface to a maximum thickness of 1-1/2 inch.
- B. Dampen and roller compact sand to level and even surface.
- C. Screed and scarify top 1 inch to 1 1/2 inch of sand.
- D. Cut paver units at edges with masonry saw.
- E. Place half units at edge and interruptions. Maintain tight joints.
- F. Tamp and level paver units with mechanical vibrator until units are firmly bedded, level, and to correct elevation and gradients. Do not tamp unrestrained edges.

3.04 CLEANING

- A. Do not clean pavers until pavers and mortar are dry.
- B. Clean soiled surfaces using cleaning solution. Do not harm pavers, joint materials, or adjacent surfaces.
- C. Use non-metallic tools in cleaning operations.
- D. Rinse surfaces with clean water.
- E. Broom clean paving surfaces. Dispose of excess sand.
- F. See Section 01 74 19 for construction waste management and disposal.

3.05 PROTECTION

- A. Do not permit traffic over unprotected paver surface.
- B. Do not permit traffic for 48 hours after pavement placement.

3.06 MAINTENANCE

- A. See Section 01 70 00 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide a separate maintenance contract for specified maintenance service.

END OF SECTION

SECTION 32 17 13 CONCRETE WHEEL STOPS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete parking bumpers and anchorage.

1.02 RELATED REQUIREMENTS

- A. Section 32 17 23 - Pavement Markings.

1.03 REFERENCE STANDARDS

- A. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement; 2022.
- B. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- C. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a (Reapproved 2016).
- D. ASTM C330/C330M - Standard Specification for Lightweight Aggregates for Structural Concrete; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide unit configuration, dimensions.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Parking Bumpers: Precast concrete, complying with the following:
 - 1. Profile: Manufacturer's standard.
 - 2. Cement: ASTM C150/C150M, Portland Type I - Normal; white color.
 - 3. Concrete Materials: ASTM C330/C330M aggregate, water, and sand.
 - 4. Reinforcing Steel: ASTM A615/A615M, deformed steel bars; unfinished, strength and size commensurate with precast unit design.
 - 5. Air Entrainment Admixture: ASTM C260/C260M.
 - 6. Concrete Mix: Minimum 5,000 psi compressive strength after 28 days, air entrained to 5 to 7 percent.
 - 7. Use rigid molds, constructed to maintain precast units uniform in shape, size and finish. Maintain consistent quality during manufacture.
 - 8. Embed reinforcing steel, and drill or sleeve for two dowels.
 - 9. Cure units to develop concrete quality, and to minimize appearance blemishes such as non-uniformity, staining, or surface cracking.
 - 10. Minor patching in plant is acceptable, providing appearance of units is not impaired.
- B. Dowels: Cut reinforcing steel, 1/2 inch diameter, 18 inch long, pointed tip.

- C. Adhesive: Epoxy type.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install units without damage to shape or finish. Replace or repair damaged units.
- B. Install units in alignment with adjacent work.
- C. Fasten units in place with 2 dowels per unit.

END OF SECTION

SECTION 32 17 23 PAVEMENT MARKINGS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Painted pavement markings.
 - 1. Accessible Parking Spaces.
 - a. Passenger Loading Zone
 - b. Bus Loading Zone
 - 2. EV parking Spaces
 - 3. Exterior athletic court markings.
 - 4. Playground markings.
 - 5. Existing Striping: Confirm compliance at all accessible parking spaces on site and path of travel with California Building Code and Access requirements.
 - a. Remove non-compliant and provide all striping and modifications necessary for compliance.

1.02 RELATED REQUIREMENTS

- A. Section 32 12 16 - Asphalt Paving.
- B. Section 32 13 13 - Site Concrete.
- C. Section 32 17 26 - Tactile Warning Surfacing.

1.03 REFERENCE STANDARDS

- A. AASHTO M 247 - Standard Specification for Glass Beads Used in Pavement Markings.
- B. AASHTO MP 24 - Standard Specification for Waterborne White and Yellow Traffic Paints.
- C. ADA Standards - 2010 ADA Standards for Accessible Design.
- D. CBC Chapter 11B - California Building Code-Chapter 11B.
- E. FS TT-B-1325 - Beads (Glass Spheres) Retro-Reflective.
- F. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne.
- G. SAE AMS-STD-595 - Colors Used in Government Procurement.
- H. SAE AMS-STD-595A - Colors Used in Government Procurement.
- I. SCAQMD 1113 - Architectural Coatings.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the work of this section with adjoining work.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.

1.05 SUBMITTALS

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

- B. Product Data: Manufacturer's data sheets on each product to be used.
- C. Certificates: Submit for each batch stating compliance with specified requirements.
 - 1. Painted pavement markings.
- D. Manufacturer's Instructions:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Maintenance Materials: Furnish the following for District's use in maintenance of project.
 - 1. See Section 01 60 00 - Product Requirements for additional provisions.
 - 2. Extra Paint: 2 containers, 1 gallon size, of each type and color.
 - 3. Extra Markers: 5 percent, of each type and color.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver paint in containers of at least 5 gallons accompanied by batch certificate.
- B. Deliver glass beads in containers suitable for handling and strong enough to prevent loss during shipment, accompanied by batch certificate.
- C. Store products in manufacturer's unopened packaging until ready for installation.
- D. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.08 FIELD CONDITIONS

- A. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Do not apply paint if temperature of surface to be painted or the atmosphere is less than 50 degrees F or more than 95 degrees F.
 - 1. Do not apply marking paint when weather is foggy or rainy, or when such conditions are anticipated within eight hours of application.
 - 2. Do not apply marking paint when wind velocity causes uncontrollable overspray or excessively rapid drying.
- C. Sequence and Schedule: Apply pavement markings after asphaltic concrete and portland cement concrete and interlocking concrete paving Work are complete and properly cured and, if applicable, sealer has been applied to asphaltic concrete and landscaping Work is complete.
 - 1. Allow new pavement surfaces to cure for a period of not less than 14 days before application of marking materials.

1.09 SEQUENCING

- A. Allow new pavement surfaces to cure for a period of not less than 14 days before application of markings.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS:

- A. Comply with CalGreen requirements.
 - 1. Comply at time of installation with Air Quality standards of:
 - a. South Coast Air Quality Management District, SCAQMD 1113.
 - b. California Air Resources Board (CARB).
- B. For accessibility markings see Part 3 Article "Installation".
- C. Conform to State of California, Department of Transportation (CALTRANS) Standard Specifications, Section 84, Traffic Control Markings, as amended and adopted by authorities having jurisdiction.
- D. 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. For conditions not indicated otherwise on Contract Drawings, conform to Standard Details adopted by authorities having jurisdiction, including SSPWC Greenbook.
 - 2. Perform on-site Work as indicated and referenced on the Contract Drawings and as specified herein.

2.02 MANUFACTURERS

- A. Painted Pavement Markings: FS TT-P-1952 Type II.
 - 1. Behr: www.behr.com.
 - 2. Dunn-Edwards Corporation; Vin-L-Stripe Specialty Interior/Exterior Flat Zone Marking Paint.
 - 3. PPG Traffic Solutions; Ennis Flint Fast Dry Waterborne Traffic Paint, 9852x Series.
 - 4. Sherwin Williams; 2 Coats of SW Armorseal 8100 with Armorseal High Wear Additive in second coat: www.sherwin.com.
 - 5. Vista Paint Corporation; 6700 100% Acrylic Traffic Marking Paint: www.vistapaint.com.
 - 6. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 PAINTED PAVEMENT MARKINGS

- A. General: Provide standard factory-mixed, quick drying and non-bleeding colors, conforming to Standard Specifications, as amended and adopted by the AHJ, City, and County, as applicable.
- B. Painted Pavement Markings: As indicated on drawings.
 - 1. Marking Paint: In accordance with AASHTO MP 24 or FS TT-P-1952; water emulsion-based traffic paint.
 - a. Parking Lots: Color(s) as indicated.

- 1) Fast-dry type. If required by authorities having jurisdiction for Work in public rights-of-way, include reflective material in paint. Paint for marking curbs shall not require reflective material. See Color Schedule in Part 3.
 - b. Symbols and Text: Color(s) as indicated.
 - 1) Accessibility Symbols: Provide blue and white, per CBC Chapter 11B-503 and CBC Chapter 11B-703.7.2.
 - (a) Blue shall conform to Color No. 15090; SAE AMS-STD-595A (formerly 595C).
2. Recreational Area Paint:
 - a. Color: To be selected by Architect from full range.
3. Reflective Glass Beads at Accessible Parking Spaces: Type 1 (low index of refraction), Gradation A (coarse, drop-on); with silicone or other suitable waterproofing coating to ensure free flow, in accordance with AASHTO MP 24 or FS TT-P-1952.
 - a. Comply with CBC Chapter 11B-502.6.4 Marking.
4. Comply with CALTRANS State Specification No. 8010-51J-22, Type II, and CBC Chapter 11B-502.6 Identification.
5. Obliterating Paint: Type I, in accordance with AASHTO MP 24 or FS TT-P-1952.
 - a. Bituminous Pavement: Black.
 - b. Concrete Pavement: Gray.
- C. Temporary Marking Tape: Preformed, reflective, pressure sensitive adhesive tape in color(s) required; Contractor is responsible for selection of material of sufficient durability as to perform satisfactorily during period for which its use is required.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Identify existing markings for removal.
- B. Verification of Conditions: Verify that pavement is dry and ready for installation.
- C. Notify Architect of unsatisfactory conditions before proceeding.

3.02 PREPARATION

- A. Establish survey control points for locating and dimensioning of markings.
 1. Lay out markings as shown on Drawings. Use guide lines, templates and forms for precise edges and spacings.
 - a. At off-site and on-site public rights-of-way, obtain review and approval of layout by authorities having jurisdiction.
- B. Clean surfaces prior to installation.
 1. Remove dust, dirt, and other debris.
 2. Remove rubber deposits, existing paint markings, and other coatings.
- C. Temporary Markings: Apply as directed by Architect.
- D. Apply paint stencils by type and color at necessary intervals.

3.03 INSTALLATION

A. Regulatory Accessibility Requirements for Installation:

1. Pavement markings for accessibility requirements shall meet requirements of California Building Code (CBC), Title 24, Part 2, CBC Section 11B and ADA Standards, per latest amendments.
 - a. Accessible parking spaces serving a particular building or facility shall be located on the shortest accessible route to an entrance complying with CBC Section 11B-208.3.1.
 - b. Accessible parking spaces serving more than one accessible entrance shall be dispersed and located on the shortest accessible route to the accessible entrances.
 - c. Accessible parking spaces in a parking facility not serving a particular building or facility shall be located on the shortest accessible route to an accessible pedestrian entrance of the parking facility. CBC Section 11B-208.3.1
 - d. Minimum number of required accessible parking spaces shall be provided in accordance with CBC Section 11B Table-208.2 for each parking facility provided on a site.
 - e. For every six or fraction of six accessible parking spaces, at least one shall be an accessible van parking space. CBC Section 11B-208.2.4
 - f. Accessible parking spaces and access aisles shall comply with CBC Section 11B-502 and shall be dimensioned to the centerline of the marked lines as follows:
 - 1) Parking spaces and access aisles shall be marked according to CBC Chapter 11B Figures 11B-502.2, 11B-502.3, and 11B-502.3.3.
 - (a) Their surfaces shall comply with CBC Section 11B-302 and shall be at the same level with slopes not steeper than 1:48 in any direction. CBC Section 11B-502.4.
 - 2) Parking spaces shall be 9 x 18 feet minimum and van parking spaces shall be 12 x 18 feet minimum with an adjacent access aisle of 5 x 18 feet minimum.
 - (a) Access aisles shall be placed on either side of the parking spaces except be located on the passenger side for van parking spaces.
 - (b) Van parking spaces shall be permitted to be 9 x 18 feet minimum where the access aisle is 8 x 18 feet minimum.
 - 3) Access aisles shall be marked by a blue painted borderline around their perimeter.
 - (a) The area within the blue borderlines shall be marked with hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface, preferably blue or white.
 - (b) Access aisle markings may extend beyond the minimum required length. CBC Section 11B-502.3.3
 - (c) At drive aisle provide minimum 12 inch high white letters with the text "NO PARKING" per CBC Section 11B Figure 11B-502.3.3.
 - 4) Access aisles (parking spaces as well- similar application) shall not overlap the vehicular way. CBC Section 11B-502.3.4
 - 5) A vertical clearance of 98 inches minimum shall be provided for accessible parking spaces, access aisles, and vehicular routes serving them. CBC Section 11B-502.5

2. Passenger Drop-Off and Loading Zones: At least one passenger loading zone shall be provided in every continuous 100 linear feet of loading zone space, or fraction thereof, complying with CBC Section 11B-209 and 11B-503 as follows:
 - a. Vehicle pull-up spaces shall be 8 x 20 feet minimum.
 - 1) Access aisles shall be 5 feet wide minimum x full length of vehicle pull-up spaces they serve and shall be adjacent and parallel to the vehicular pull-up spaces.
 - 2) They shall be at the same level with slopes not steeper than 1:48 in any direction.
 - 3) Access aisle shall adjoin an accessible route and shall not overlap the vehicular way.
 - b. Access aisles for passenger drop-off and loading zone shall be marked with a painted borderline around their perimeter.
 - 1) The area within the borderlines shall be marked with hatched lines a maximum of 36 inches on center in a color contrasting with that of the aisle surface. CBC Section 11B-503.3.3.
 - (a) Blue perimeter lines with blue interior hatch lines are preferred for concrete surfaces and blue perimeter lines with white interior hatch lines are preferred for asphalt surfaces.
 - (b) Where white hatch lines are used, hatch lines shall be interrupted at 12 inch high "No Parking" text so that legibility is maintained.
 - c. A vertical clearance of 114 inches minimum shall be provided for vehicle pull-up spaces, access aisles, and a vehicular route serving them connecting a vehicular entrance and a vehicular exit. CBC Section 11B-503.5.
3. Bus loading zones and bus stops shall comply with CBC Section 11B-209 and 11B-810.2 as follows:
 - a. Boarding and alighting areas shall be of 8 x 5 feet minimum, with 8 feet measured perpendicular to the curb or vehicle roadway edge, and with 5 feet measured parallel to the vehicle roadway.
 - 1) Slopes in 8 foot direction shall be 1:48 maximum.
 - 2) Slopes in 5 foot direction shall be the same as that of the roadway, to the maximum extent practicable. CBC Section 11B Figure 11B-810.2.2.
 - b. Bus shelters shall provide a minimum 30 x 48 inches clear floor or ground space (36 x 48 inches or 36 x 60 inches in an alcove per CBC Section 11B-305.7), with slopes not steeper than 1:48 in any direction, entirely within the shelter complying with CBC Section 11B-305.
 - c. Bus shelters shall be connected by an accessible route complying with CBC Section 11B-402 to a boarding and alighting area complying with CBC Section 11B-810.2 and Figure 11B-810.3.
 - d. Newly constructed bus stop boarding and alighting areas shall provide a detectable transition between the boarding/alighting area and the roadway; the detectable transition shall consist of a curb with the face sloped at 35 degrees maximum from vertical or detectable warnings complying with CBC Section 11B-705.1.1 and 11B-705.1.2.4.
4. Electric Vehicle Charging Stations:

- a. Where Electric Vehicle Charging Stations are provided, they shall be provided in accordance with CBC Section 11B-228.3, Table 11B-228.3.2.1 and CBC Section 11B-812 (see 11 11 36 - Vehicle Charging Equipment for additional requirements).
- b. Accessibility requirements for Public Use or Common Use EVCS facilities:
 - 1) Vehicle spaces and access aisles serving them shall comply with CBC Section 11B-302. Access aisles shall be at the same level as the vehicle space they serve. Changes in level, slopes exceeding 1:48, and detectable warnings shall not be permitted in vehicle spaces and access aisles. CBC Section 11B-812.3
 - 2) Vehicle spaces, access aisles serving them and vehicular routes serving them shall provide a vertical clearance of 98 inches minimum. CBC Section 11B-812.4.
 - 3) Accessible routes between EVCS parking, equipment and the building or facility served shall be provided per CBC Section 11B-812.5
 - 4) Vehicle spaces for van accessible, standard accessible, ambulatory and drive-up EVCS shall meet minimum length and width requirements per CBC Section 11B-812.6.
 - 5) Accessible EVCS stalls shall be marked "EV Charging Only" per CBC Section 11B-812.9 and Figure 11B-812.9.
 - 6) Access aisles for van accessible and standard accessible EVCS shall meet minimum length and width requirements and be marked per CBC Section 11B-812.7 the color of the perimeter, hatch lines and "No Parking" letters shall contrast with the surface color (blue color required for use at non-EVCS accessible parking shall not be used).
 - 7) Identification Signs (ISA):
 - (a) Where four or fewer total EVCS are provided, identification with an International Symbol of Accessibility (ISA) shall not be required.
 - (b) Where five to twenty-five total EVCS are provided, one van-accessible EVCS shall be identified with an ISA complying with CBC Section 11B-703.7.2.1. The required standard accessible EVCS shall not be required to be marked with an ISA.
 - (c) Where twenty-six or more EVCS are provided, all required van-accessible and all required standard accessible EVCS shall be identified with an ISA.
 - (d) The required ISA identification sign shall be reflective with a minimum 70 square inches, shall be visible from the EVCS it serves. The sign shall be permanently posted either immediately adjacent to the vehicle space or within the projected vehicle space at the head end of the vehicle space. Signs identifying van accessible vehicle spaces shall contain the designation "Van Accessible". Signs shall be minimum 60 inches above the finish surface except that if the sign projects into a pedestrian circulation area, they shall be minimum 80 inches above finish surface CBC Section 11B-812.8
 - 8) Ambulatory EVCS complying with CBC Section 11B-812.6.3 shall be required where 26 or more EVCS are provided. CBC Chapter 11B Table 11B-228.3.2.1

B. General:

1. Position pavement markings as indicated on drawings.
2. Field location adjustments require approval of Architect.

C. Painted Pavement Markings:

1. Apply in accordance with manufacturer's instructions.
2. Obliterating Paint: Apply as necessary to cover existing markings completely.
3. Marking Paint: Apply uniformly, with sharp edges.
 - a. Applications: One coat.
 - b. Wet Film Thickness: 0.015 inch, minimum.
 - c. Stencils: Lay flat against pavement, align with striping, remove after application.
 - d. Glass Beads: Apply directly to paint, 10 second lag time, 6 lbs/gal of paint, uniform thickness and coverage.
 - e. Length Tolerance: Plus or minus 3 inches.
 - f. Width Tolerance: Plus or minus 1/8 inch.
4. Curbs: Paint full vertical face and first 6-inches of horizontal plane at top of curb or combination curb/paving. Provide minimum 2 coats paint.
 - a. Provide stenciled text in the height, spacing and typeface as indicated on Drawings.
5. Parking Lots: Apply parking space lines, entrance and exit arrows, painted curbs, and other markings indicated on drawings.
 - a. Mark the International Symbol of Accessibility at indicated parking spaces.
 - 1) Accessibility Logo: Provide minimum of 2 coats paint.
 - (a) Comply with CBC Chapter 11B Figure 703.7.2.1.
 - 2) Stall Marking:
 - (a) Use single-line style striping between parking stalls, unless otherwise indicated.
 - (b) Comply with local agency regulatory requirements.
 - (c) Accessible Stalls: Comply with ADA Standards, CBC Chapter 11B, and local agency regulatory requirements.
 - (1) Painted lines and markings on pavement shall be minimum 3 inches wide, color as indicated on Drawings
 - (2) Tactile warning lines shall comply with CBC Chapter 11B-705.1.2.5 Hazardous Vehicular Areas.
 - (3) Tactile warning devices shall comply with CBC Chapter 11B, see Section 32 17 26 - Tactile Warning Surfacing.
 - 3) Hatching: Provide hatching in parking areas, including accessible parking stalls, as indicated on Contract Drawings or as required by Standard Details. Should Contract Drawings and Standard Details conflict, comply with the more stringent.
 - b. Hand application by pneumatic spray is acceptable.
6. Symbols: Use a suitable template that will provide a pavement marking with true, sharp edges and ends, of the design and size indicated.
7. Recreational Areas: Provide minimum 2 coats paint.

3.04 TOLERANCES

- A. Maximum Variation From True Position: 3 inches (76 mm).
- B. Maximum Offset From True Alignment: 3 inches (76 mm).

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field inspection for deviations from true alignment or material irregularities.
- C. If inspections indicate work does not meet specified requirements, rework and reinspect at no cost to District.
- D. Allow the pavement marking to set at least the minimum time recommended by manufacturer.

3.06 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals for additional requirements.
- B. Temporary Markings: Remove without damaging surfaces.

3.07 PROTECTION

- A. Replace damaged or removed markings at no additional cost to District.
- B. Preserve survey control points until pavement marking acceptance.

3.08 COLOR SCHEDULE

- A. Parking and On-Site Roadways

<u>Location</u>	<u>Color</u>	<u>Reflectance**</u>
Driving lane striping	White	82%
Parking space striping	White	82%
Accessible Parking, field behind ISA, and zone markings	Blue No. 15090 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
Accessible Parking ISA, loading and cross-hatching	A. White with Blue perimeter at Asphalt Paving. B. Blue at Concrete Paving*	82% / 52% 52%
12 inch high Text: "NO PARKING", "LOADING ZONE", and "FIRE LANE", etc.	White	82%
Firelanes / No Parking zone markings Special Use Markings	Red No. 31350 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
Loading zone markings	Orange Yellow No. 33538 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
Directional arrows	White	82%
Speed Bumps	Orange Yellow No. 33538 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
Black special-use pavement markings, if indicated on	Black No. 37038 per SAE AMS-STD-595A (formerly FED-STD-	NA

Drawings	595C)	
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*Contrasting color per CBC.

a. See also Division of the State Architect IR 11B-7.

**Daylight directional reflectance (without glass beads) , when tested in accordance with Federal Test Method Standard 141A, Method 612.

B. Electrical Vehicle Charging Station (EVCS):

<u>Location</u>	<u>Color</u>	<u>Reflectance*</u>
EVCS Parking space striping	Yellow No. 33655 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
12 inch high Text: "EV CHARGING ONLY" CBC 11B-812.9	Yellow No. 33655 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
EVCS Accessible Parking, ISA, and zone markings. CBC Table 11B-228.3.2.1 1-4 EVCS Spaces: Provide space sized for van accessible use. Signage not required. CBC 11B-812.8.1 5-25 EVCS spaces: Provide one van and one standard accessible signage and ISA. >25 EVCS Spaces: Provide at each required accessible space.	Yellow No. 33655 per SAE AMS-STD-595A (formerly FED-STD-595C)	52%
Accessible loading and cross-hatching. 12 inch high Text: "EV CHARGING ONLY" CBC 11B-812.8 "NO PARKING" CBC Figure 11B-812.9	Yellow No. 33655 per SAE AMS-STD-595A (formerly FED-STD-595C) Do not use blue.	52%

*Daylight directional reflectance (without glass beads) , when tested in accordance with Federal Test Method Standard 141A, Method 612.

C. Athletic Courts and Recreational Areas

<u>Location</u>	<u>Color</u>
Athletic Court Lines on asphalt	White*
Athletic Court Lines on concrete	Yellow*

*Exterior Recreational Use: Marking Width and Color; Unless indicated otherwise on Drawings.

a. Athletic Court Lines: 2 inches White

- b. Where two sets of lines overlap, one set provide one in white and the other set yellow or as indicated on Drawings.

END OF SECTION

SECTION 32 17 26 TACTILE WARNING SURFACING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Tactile warning surfacing for pedestrian walking surfaces.

1.02 RELATED REQUIREMENTS

- A. Section 32 13 13 - Site Concrete: Concrete sidewalks.
- B. Section 32 17 23 - Pavement Markings: Crosswalk and curb markings.

1.03 REFERENCE STANDARDS

- A. 49 CFR 37 - Transportation Services for Individuals with Disabilities (ADA); current edition.
- B. AASHTO LRFD - Bridge Design Specifications; 2020, with Errata (2021).
- C. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2023.
- E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- F. ASTM C501 - Standard Test Method for Relative Resistance to Wear of Unglazed Ceramic Tile by the Taber Abraser; 2021.
- G. ASTM C903 - Standard Practice for Preparing Refractory Specimens by Cold Gunning; 2015 (Reapproved 2020).
- H. ASTM D2047 - Standard Test Method for Static Coefficient of Friction of Polish-Coated Flooring Surfaces as Measured by the James Machine; 2017.
- I. ASTM D543 - Standard Practices for Evaluating the Resistance of Plastics to Chemical Reagents; 2021.
- J. ASTM D570 - Standard Test Method for Water Absorption of Plastics; 2022.
- K. ASTM D638 - Standard Test Method for Tensile Properties of Plastics; 2022.
- L. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics; 2023.
- M. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials; 2017.
- N. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2023d.
- O. ASTM G155 - Standard Practice for Operating Xenon Arc Lamp Apparatus for Exposure of Materials; 2021.
- P. ATBCB PROWAG - Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way; 2011.
- Q. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- R. SAE AMS-STD-595 - Colors Used in Government Procurement; 2017a.
- S. SAE AMS-STD-595A - Colors Used in Government Procurement; 2021.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's product data, standard details, details specific to this project; written installation and maintenance instructions.
- C. Samples: For each product specified provide two samples, 8 inches square, minimum; show actual product, color, and patterns.
- D. Shop Drawings: Submit plan and detail drawings. Indicate:
 - 1. Locations on project site. Demonstrate compliance with referenced accessibility standards.
 - 2. Sizes and layout.
 - 3. Pattern spacing and orientation.
 - 4. Attachment and fastener details, if applicable
- E. Manufacturer's Qualification Statement.
- F. Installer's Qualification Statement.
- G. Warranty: Submit manufacturer warranty; complete forms in District's name and register with manufacturer.

1.05 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than five years documented experience.
- B. Installer Qualifications: Company certified in writing by product manufacturer as having successfully completed work substantially similar to the work of this section.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Deliver to project site in manufacturer's protective wrapping and in manufacturer's unopened packaging.
- B. Store covered and elevated above grade and in manufacturer's unopened packaging until ready for installation. Maintain at ambient temperature between 40 and 90 degrees F.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Plastic Tiles: Provide manufacturer's standard five year warranty against manufacturing defects, breakage or deformation.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Detectable warnings shall comply with California Building Code, CBC Ch. 11B-705.1 requirements, CBC Ch. 11B-705.1.2 Locations and CBC Ch. 11B-705.1.2.5 Blended Transitions, for special warnings for disabled persons.
- B. Nominal dimensions meeting CBC Ch. 11B-705.1.2 Locations.
- C. Detectable warning surfaces at transit boarding platform edges, bus stops, hazardous vehicle areas, reflecting pools, and track crossings shall be yellow and approximate to Federal Color No. 33538 of SAE AMS-STD-595A (Table IV of Federal Standard No. 595A).

1. Detectable warning surfaces at other locations shall be the aforementioned yellow or a color providing a 70 percent minimum visual contrast with that of adjacent walking surfaces.
 2. The material used to provide visual contrast shall be an integral part of the surface. CBC Ch. 11B-705.1.1.3.
- D. Detectable warning surfaces shall differ from adjoining surfaces in resiliency or sound-on-cane contact. Such constraint shall not be required for detectable warning surfaces at curb ramps, islands, or cut-through medians. CBC Ch. 11B-705.1.1.4 Resiliency.
- E. Truncated dome pattern in-line, not staggered.

2.02 MANUFACTURERS

- A. Plastic Tactile and Detectable Warning Surface Tiles:
1. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.03 TACTILE AND DETECTABLE WARNING DEVICES

- A. Plastic Tactile and Detectable Warning Tiles: Comply with ADA Standards, glass fiber and carbon fiber reinforced, exterior grade, matte finish polyester sheet with truncated dome pattern, solid color throughout, internal reinforcing of sheet and of truncated domes, integral radius cut lines on back face of tile; with factory-applied removable protective sheeting.
1. Material Properties:
 - a. Water Absorption: 0.20 percent, maximum, when tested in accordance with ASTM D570.
 - b. Slip Resistance: 0.50 minimum dry static coefficient of friction, when tested in accordance with ASTM D2047.
 - c. Compressive Strength: 25,000 pounds per square inch, minimum, when tested in accordance with ASTM D695.
 - d. Tensile Strength: 10,000 pounds per square inch, minimum, when tested in accordance with ASTM D638.
 - e. Flexural Strength: 25,000 pounds per square inch minimum, when tested in accordance with ASTM D790.
 - f. Chemical Stain Resistance: No reaction to 1 percent hydrochloric acid, motor oil, calcium chloride, gum, soap solution, bleach, or antifreeze, when tested in accordance with ASTM D543.
 - g. Abrasion Resistance: 300, minimum, when tested in accordance with ASTM C501.
 - h. Flame Spread Index: 25, maximum, when tested in accordance with ASTM E84.
 - i. Accelerated Weathering: Delta-E of less than 5.0 at 2,000 hours exposure, when tested in accordance with ASTM G155.
 - j. Adhesion: No delamination of tile prior to board failure in a temperature range of 20 to 180 degrees F, when tested in accordance with ASTM C903.
 - k. Loading: No damage when tested according to AASHTO LRFD test method HS20.
 - l. Salt and Spray Performance: No deterioration or other defect after 200 hours of exposure, when tested in accordance with ASTM B117.
 2. Asphalt Installation Method: Surface applied.
 3. Concrete Installation Method: Cast in place.
 4. Shape: Rectangular.

5. Dimensions: 36 inches by 48 inches, nominal. Other sizes may be indicated on Drawings.
6. Pattern: In-line pattern of truncated domes complying with ADA Standards.
7. Edge: ADA Standards compliant bevel.
8. Joint: Butt.
9. Color: SAE AMS-STD-595, Table IV, Federal Yellow No. 33538.
10. At Asphalt Application Basis of Design Product: SSTD Traditional Mat System as manufactured by Safety Step TD; www.safetystepTD.com, or approved equal.
11. Surface Applied Products:
 - a. Access Tile, a brand of Access Products, Inc; Surface Applied Tile: www.accesstile.com/#sle.
 - b. ADA Solutions, a division of SureWerx USA; Surface Applied System: www.adatile.com/#sle.
 - c. Detectable Warning Systems, Inc.; redimat (Surface Applied): detectable-warning.com.
 - d. Safety StepTD, Inc.; SSTD-Traditional Mat System: www.safetystepTD.com.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.
12. At Flush Concrete Application Basis of Design Product: Armor-Tile as manufactured by Engineered Plastics, or approved equal.
13. Concrete Recessed/Flush Products:
 - a. Access Tile, a brand of Access Products, Inc; Cast in Place Replaceable Tactile Warning Tile: www.accesstile.com/#sle.
 - b. ADA Solutions, a division of SureWerx USA; Cast in Place Replaceable (Wet-Set): www.adatile.com/#sle.
 - c. Armor Tile by Engineered Plastics Inc.; Vitrified Polymer Composite (VPC) Cast In Place Detectable/Tactile Warning Surface Tile: armor-tile.com.
 - d. Detectable Warning Systems, Inc.; alertcast (Replaceable Cast-in-Place): detectable-warning.com.
 - e. Or Equal Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Fasteners: ASTM A666, Type 304 stainless steel
 1. Type: Countersunk, color matched composite sleeve anchors
 2. Size: 1/4 inch diameter and 1-1/2 inches long.
- B. Adhesive: Type recommended and approved by surfacing tile manufacturer.
- C. Sealant: Elastomeric sealant of color to match adjacent surfaces; approved by surfacing tile manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION

- A. When installation location is near site boundary or property line, verify required location using property survey.
- B. Verify that work area is ready to receive work:

1. Examine work area with installer present.
 2. If existing conditions are not as required to properly complete the work of this section, notify Architect.
 3. Do not proceed with installation until deficiencies in existing conditions have been corrected.
- C. Verify that dimensions, tolerances, and attachment methods for work in this section are properly coordinated with other work on site.

3.02 INSTALLATION, GENERAL

- A. Install in accordance with manufacturer's written instructions.
1. Do not install damaged, warped, bowed, dented, abraded, or otherwise defective units.
 2. Do not install when ambient or substrate temperature has been below 40 degrees F during the preceding 8 daylight hours.
- B. Field Adjustment:
1. Cut units to size and configuration shown on drawings. (If required)
 2. Do not cut plastic tiles to less than 9 inches wide in any direction.
 3. Locate relative to curb line in compliance with ATBCB PROWAG, Sections 304 and 305.
 4. Orient so dome pattern is aligned with the direction of ramp.
 5. Align truncated dome pattern between adjacent units.
- C. Install units fully seated to substrate, square to straight edges and flat to required slope.
- D. Align units so that tops of adjacent units are flush and joints between units are uniform in width.

3.03 INSTALLATION, CAST IN PLACE PLASTIC TILES

- A. Concrete:
1. See Section 32 13 13 - Site Concrete.
 2. Slump: 4 to 7 percent.
- B. When installing multiple adjacent units, leave a 3/16 inch gap between units to allow for expansion.
- C. Tamp and vibrate units as recommended by manufacturer.
- D. Place and position weights on units while concrete cures as recommended by manufacturer. Ensure no voids or air pockets exist between top surface of concrete and underside of units.

3.04 INSTALLATION, SURFACE APPLIED PLASTIC TILES

- A. Cure asphalt surfaces for a minimum of 4 days before installing units.
- B. Verify substrate is clean and dry; free of voids, projections and loose material. Remove dust, oil, grease, curing compounds, sealers and other substances that may interfere with adhesive bond or sealant adhesion.
- C. Mechanically roughen surface as required to remove contaminants and prepare surface for adhesive and sealant application.
- D. When installing multiple adjacent units, leave a 1/8 inch gap between tiles to allow for expansion.
- E. Drill fastener holes straight, true and to depth recommended by manufacturer.
- F. Apply adhesive to back of unit as recommended by manufacturer.

- G. Mechanically fasten to substrate. Avoid striking or damaging the unit itself during installation.
- H. Apply sealant to edges in cove profile.

3.05 CLEANING PLASTIC UNITS

- A. Remove protective plastic sheeting within 24 hours of installation.
- B. Remove excess sealant or adhesive from joints and edges.
- C. Clean four days prior to date of scheduled inspection.

3.06 PROTECTION

- A. Protect installed units from traffic, subsequent construction operations or other imposed loads until concrete is fully cured.
- B. Touch-up, repair or replace damaged products prior to Date of Substantial Completion.

END OF SECTION

SECTION 32 31 19 DECORATIVE METAL FENCES AND GATES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Decorative steel fences.
- B. Excavation for post bases; concrete foundation for posts and center drop for gates.

1.02 RELATED REQUIREMENTS

- A. Section 05 50 00 - Metal Fabrications: Custom fabricated metal components.
- B. Section 31 23 16 - Excavation: Excavation for footings.
- C. Section 32 13 13 - Concrete Paving: : Concrete anchorage for posts.

1.03 REFERENCE STANDARDS

- A. ADA Standards - 2010 ADA Standards for Accessible Design; 2010.
- B. ASTM A276/A276M - Standard Specification for Stainless Steel Bars and Shapes; 2024.
- C. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes; 2023.
- D. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2023.
- E. ASTM B117 - Standard Practice for Operating Salt Spray (Fog) Apparatus; 2019.
- F. ASTM D523 - Standard Test Method for Specular Gloss; 2014 (Reapproved 2018).
- G. ASTM D714 - Standard Test Method for Evaluating Degree of Blistering of Paints; 2002 (Reapproved 2017).
- H. ASTM D822/D822M - Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings; 2013 (Reapproved 2018).
- I. ASTM D1654 - Standard Test Method for Evaluation of Painted or Coated Specimens Subjected to Corrosive Environments; 2008, with Editorial Revision (2017).
- J. ASTM D2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates; 2023.
- K. ASTM D2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact); 1993 (Reapproved 2024).
- L. ASTM D3359 - Standard Test Methods for Rating Adhesion by Tape Test; 2023.
- M. ASTM F2408 - Standard Specification for Ornamental Fences Employing Galvanized Steel Tubular Pickets; 2016 (Reapproved 2023).
- N. AWS D1.1/D1.1M - Structural Welding Code - Steel; 2020, with Errata (2023).
- O. SSPC-Paint 20 - Zinc-Rich Coating (Type I - Inorganic, and Type II - Organic); 2019.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to start of work of this section; require attendance by affected installers.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Submit manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings:
 - 1. Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.
- D. Installer's Qualification Statement.
- E. Project Record Documents: Accurately record actual locations of property perimeter posts relative to property lines.
- F. Field Inspection Records: Provide installation inspection records that include post settings, framework, fittings and accessories, gates, and workmanship.
- G. Manufacturer's Warranty.
- H. Maintenance Materials: Furnish the following for District's use in maintenance of project:
 - 1. See Section 01 60 00 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with minimum five years documented experience.
- B. Installer Qualifications: Experienced with type of construction involved and materials and techniques specified and approved by fence manufacturer.
- C. Fabricator's Qualifications: Fabricator of light structural steel framing members and other miscellaneous metal fabrications of structural character shall have a minimum 5 years experience fabricating similar fences and gates and shall be approved by the Building Official in accordance with applicable Code provisions.
- D. Welder's Qualifications: Welding shall be performed by certified welders qualified in accordance with procedures specified in applicable referenced AWS standard, using materials, procedures and equipment of the type required for the Work. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone re-certification.
- E. Coordination: Provide templates and sleeves for incorporation of embedded items into the work specified elsewhere herein or in other Sections.
- F. Field-Verified Dimensions: Prior to fabrication, field verify dimensions and details of construction. Immediately report variances in writing to Architect.

1.07 DELIVERY, STORAGE AND HANDLING

- A. Store materials in a manner to ensure proper ventilation and drainage. Protect against damage, weather, vandalism and theft.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

- C. Provide ten year warranty for finish.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS:

- A. Provide fences and gates meeting life safety and accessibility requirements of California Building Code (CBC) Title 24, Part 2, Chapters 10 and 11B; and ADA Standards, per latest amendments.
1. Gates that are part of the accessible route shall meet all the requirements of an accessible door in compliance with CBC Section 11B-404 and 11B-206.5.
 2. Gate Hardware: Meet the requirements of CBC 11B-206.5 and 11B-404.2.9.
 - a. Latch: Latch, including padlock eye as integral part of latch, mounted 40 inches above finish grade. Comply with California Fire Code.
 - b. Hardware shall comply with local Fire Authority, California Building Code (CBC) Title 24, Section 1010.2, and California Fire Code (CFC) Section 503.5.2.
 - c. The lever of lever actuated latches or locks for an accessible gate shall be curved with a return to within 1/2 inch of the (face of) gate to prevent catching on the clothing or persons. California Referenced Standards Code T-24 Part 12, Section 12-10-202, Item (F).
 - d. Hand activated opening hardware, handles, pulls, latches, locks, and other operating devices for and accessible gate shall have a shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist to operate. CBC Section 11B-404.2.7 and 11B-309.4.
 3. Swing doors and gate surfaces within 10 inches of the finish floor or ground shall have a smooth surface on the push side extending the full width of the door or gate. Parts creating horizontal or vertical joints in these surfaces shall be within 1/16 inch of the same plane as the other and be free of sharp or abrasive edges. Cavities created by added kick plates shall be capped. CBC Section 11B-404.2.10
 4. The bottom of the gate shall be within 3 inches of the finish surface of the path of travel. The maximum effort to operate a gate shall not exceed 5 lbf. CBC Section 11B-404.2.9.

2.02 MANUFACTURERS

- A. Decorative Metal Fences and Gates:
1. Ametco Manufacturing Corporation: www.ametco.com.
 2. Ameristar Perimeter Security, USA; ____: www.ameristarperimeter.com/#sle.
 3. Grating Pacific, Inc.: www.gratingpacific.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Automatic Gate Operators:
1. DKS DoorKing: www.doorking.com.
 2. HySecurity: www.hysecurity.com.
 3. Lift Master: www.liftmaster.com.
 4. Substitutions: See Section 01 60 00 - Product Requirements.

2.03 FENCES

- A. Fences: Complete shop-fabricated system of posts and panels, accessories, fittings, and fasteners; finished with specified coating, and having the following performance characteristics:
 - 1. Capable of resisting vertical load, horizontal load and infill performance requirements for fence categories defined in ASTM F2408.
- B. Electro-Deposition Coating: Multistage pretreatment/wash with zinc phosphate, followed by epoxy primer and acrylic topcoat.
 - 1. Total Coating Thickness: 2 mils, minimum.
 - 2. Color: As selected by Architect from manufacturer's standard range.
 - 3. Coating Performance: Comply with general requirements of ASTM F2408.
 - a. Adhesion: ASTM D3359 (Method B); Class 3B with 90 percent or more of coating remaining in tested area.
 - b. Corrosion Resistance: ASTM B117, ASTM D714 and ASTM D1654; 1/8 inch coating loss or medium No.8 blisters after 1,500 hours.
 - c. Impact Resistance: ASTM D2794; 60 inch pounds.
 - d. Weathering Resistance: ASTM D523, ASTM D822/D822M and ASTM D2244; less than 60 percent loss of gloss.
- C. Steel: ASTM A653/A653M; tensile strength 45,000 psi, minimum.
 - 1. Hot-dip galvanized; ASTM A653/A653M, G60.
 - 2. 62 percent recycled steel, minimum.
- D. Fasteners: ASTM A276/A276M, Type 302 stainless steel; finished to match fence components.
 - 1. Tamper-proof security bolts.
 - 2. Self-drilling hex-head screws.

2.04 WELDED STEEL FENCE

- A. Fence Panels: Fusion welded; 8 feet high by 10 feet long.
- B. Posts: Steel tube.
 - 1. Size: As indicated on Drawings.
 - 2. Post Cap: Flush plate, watertight.
- C. Hinged Gates:
 - 1. Steel Gate: Fabricated steel gate, ASTM A500/A500M, Grade B., Size as indicated on Drawings. See Section 05 50 00 - Metal Fabrications.
 - 2. Construction: Match adjacent fence
 - a. Provide cable kits for additional trussing for all gates leaves over 6 ft..
 - b. Infill Panel:
 - 1) Perforated Panels: ASTM A653/A653M G90 Galvanized steel panel, staggered perforated pattern. Paint to match fence.
 - c. Gate Kick Plate: Provide on push side, full width to minimum 10 inches high above finish surface, 0.1382 inch thick, galvanized ASTM A653/A653M welded to gate frame.

2.05 MECHANICALLY FASTENED STEEL FENCE

- A. Provide fence meeting requirements for Industrial class as defined by ASTM F2408.

- B. Basis of Design Product: Montage II® - Heavy Industrial Steel Ornamental Fence System – Fusion Welded and Rackable with 3-Rail Majestic Pickets as manufactured by Ameristar Perimeter Security, USA, or equal.
- C. Fence Panels: Mechanically fastened with internal reinforcement and tamperproof fasteners; 8 feet high by 6 feet long.
 - 1. Panel Style: Three rail.
 - 2. Panel Strength: Capable of supporting 600 pound load applied at midspan without deflection.
 - 3. Attach panels to posts with manufacturer's standard panel brackets.
- D. Posts: Steel tube.
 - 1. Size: 4 inches square by 12 gauge, 0.1094 inch, with manufacturer's standard cap.
 - 2. Post Cap: Ball.
- E. Rails: Manufacturer's standard, double-wall steel channel; 1-3/4 inch square by 14 gauge, 0.0747 inch with pre-punched picket holes.
 - 1. Picket Retaining Rods: 1/8 inch galvanized steel.
 - 2. Picket-to-Rail Intersection Seals: PVC grommets.
- F. Pickets: Steel tube.
 - 1. Spacing: 4.175 inch on center.
 - 2. Size: 3/4 inch square by 11 gage, 0.1233 inch.
 - 3. Style: Pickets with finial extend above top rail.
 - 4. Finial: Spear point.
- G. Flexibility: Capable of following variable slope of up to 1:4.
- H. Color: Black.

2.06 SPECIALITY HARDWARE

- A. Pedestrian Gate Hardware: Provide non-lift-off type and 180 degree opening hinges, latches, drop bolts, and other hardware required.
 - 1. See Section 08 71 00 - Door Hardware for specific item requirements.
 - 2. Hardware to comply with local Fire Authority, California Building Code (CBC) Title 24 section 1013; and California Fire Code (CFC) section 503.5.2.
 - a. Hardware to comply with CBC Section 11B-309.4.
 - 3. Double and Single Leaf Gates: Provide with mechanisms for padlocking gates in open position.
 - 4. Double Gates Not in Path of Travel or Egress: Provide gate stops set in concrete to engage center drop rod or plunger bar. Include locking device and padlock eyes as integral part of latch, permitting both gate leaves to be locked with single padlock.
 - 5. Gates across an exit to a public way or to a safe dispersal area shall have panic hardware. No padlocks or cane bolts shall be allowed.
- B. Gate Hardware, Not on on Path of Travel: <>
 - 1. Hinges:
 - a. Size and type as determined by manufacturer.
 - b. Provide 2 hinges for each leaf up to 6 feet high and 1 additional hinge for each additional 24 inches in height or fraction thereof.

2. Latch: 3/4 inch diameter slide bolt to accommodate padlock.
3. For double gates provide padlockable, 5/8 inch diameter center cane bolt assembly and strike.
- C. Hinges: Finished to match fence components.
 1. Closing: Self.
 2. Mechanism: Hydraulic.
 3. Material: Steel.
 4. Mounting: External.
 5. Brackets: Round.
 6. Bearings: Plain.
 7. Products:
 - a. Loconix; Mammoth: www.loconix.com.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.07 FABRICATION

- A. Metal Fences, Gates and Components: Fabricated of galvanized steel construction, all welded with welds ground smooth. Provide steel anchors for securing into adjoining construction. Weld anchors to frames not more than 12 inches from both top and bottom and space anchors not more than 24 inches apart.

2.08 ACCESSORIES

- A. Keypad Mounting Supports: Where not factory installed, provide mounting supports for keypad installation.
 1. Products:
 - a. StrongPoles, LLC; Architectural Keypad Pedestal: www.strongpoles.com/#sle.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Concrete: Ready-mixed, complying with ASTM C 94/C 94M; normal Portland cement; 2,500 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.
- C. Field Inspection of Fabricated Products: Prior to installation, inspect products for damage and verify markings and dimensions against reviewed submittals.
- D. Coordination: Coordinate fence and gate Work with Work specified in other Sections so that related Work shall be accurately and properly joined. Furnish templates for exact location of items to be embedded in concrete or masonry.

3.02 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Obtain Architect's review prior to site cutting or making adjustments not indicated on Drawings and reviewed shop drawings.

- C. Clean and strip site primed steel items to bare metal where site welding is necessary.
- D. Make provision for erection loads with temporary bracing. Keep work in alignment.
- E. Provide items required to be cast into concrete with setting templates. Coordinate placement with adjacent Work.
- F. Clean and prime field welds. Touch up galvanized steel with cold repair compound.

3.03 INSTALLATION

- A. Installation, General: Install items plumb and level, accurately fitted, free from distortion or defects.
- B. Install in accordance with fabricator's instructions.
- C. Set fence posts in accordance with the approved spacing.
- D. Perform field welding in accordance with AWS D1.1/D1.1M. All welds ground smooth.
- E. When cutting rails immediately seal the exposed surfaces by:
 - 1. Removing metal shavings from cut area.
 - 2. Apply zinc-rich primer or galvanizing patch compound to thoroughly cover cut edge and drilled hole; allow to dry.
 - 3. Apply two coats of custom finish spray paint matching fence color.
- F. Space gate posts according to the manufacturers' drawings, dependent on standard out-to-out gate leaf dimensions and gate hardware selected.
 - 1. Base type and quantity of gate hinges on the application, weight, height, and number of gate cycles.
 - 2. Identify the necessary hardware required for the application on the manufacturer's gate drawings.
 - 3. Provide gate hardware as specified for the gate and install per manufacturer's recommendations
- G. Excavate post holes in accordance with Section 31 23 16.
- H. Install posts in concrete by means of pipe sleeve inserts set and anchored in concrete. Fill annular space between pipe posts and sleeve inserts with grouting compound.
- I. Set line posts in concrete footing.
 - 1. Diameter: 12 inch minimum to maintain 3 inch concrete cover. Unless otherwise indicated or detailed on Drawings.
 - 2. Provide 36 inches minimum embedment of posts up to 8'-0".
 - 3. Provide 6 inches minimum concrete beneath post bottom.
- J. Provide concrete center drop to footing depth and drop rod retainers at inactive leaf, at center of double gate openings.

3.04 TOLERANCES

- A. Maximum Variation From Plumb: 1/4 inch.
- B. Maximum Offset From Indicated Position: 1 inch.
- C. Minimum Distance from Property Line: 6 inches.

3.05 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.

- B. Layout: Verify that fence installation markings are accurate to design, paying attention to gate locations, underground utilities, and property lines.
- C. Post Settings: Randomly inspect three locations against design for:
 - 1. Hole diameter.
 - 2. Hole depth.
 - 3. Hole spacing.
- D. Fence Height: Randomly measure fence height at three locations or at areas that appear out of compliance with design.
- E. Gates: Inspect for level, plumb, and alignment.
- F. Workmanship: Verify neat installation free of defects.

3.06 CLEANING

- A. Leave immediate work area neat at end of work day.
- B. Clean jobsite of excess materials; scatter excess material from post hole excavations uniformly away from posts. Remove excess material if required.
- C. Clean fence with mild household detergent and clean water rinse well.
- D. Touch up scratched surfaces using visually materials recommended by manufacturer. Match touchup paint color to fence finish.
 - 1. Galvanized Touch-Up: Touch up surfaces immediately after installation, including field welding. Prepare surface and apply cold repair compound in compliance with the product manufacturer's instructions and recommendations.
 - a. Material: SSPC-Paint 20, Type I - Inorganic, complying with VOC limitations of authorities having jurisdiction. Provide finish coat to match galvanized finish.
- E. See Section 01 74 19 - Construction Waste Management and Disposal, for additional requirements.

3.07 CLOSEOUT ACTIVITIES

- A. Demonstrate proper operation of equipment to District's designated representative.
- B. Demonstration: Demonstrate operation of system to District's personnel.
 - 1. Use operation and maintenance data as reference during demonstration.
 - 2. Briefly describe function, operation, and maintenance of each component.

3.08 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair, or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 33 13 SITE BICYCLE RACKS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Exterior bicycle racks. PC-1

1.02 RELATED REQUIREMENTS

- A. Section 32 13 13 - Site Concrete: Mounting surface for bicycle racks.

1.03 REFERENCE STANDARDS

- A. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Manufacturer's data sheets on each product to be used, including:
 - 1. Preparation instructions and recommendations.
 - 2. Storage and handling requirements and recommendations.
 - 3. Installation methods.
- C. Shop Drawings: Indicate size, shape, and dimensions, including clearances from adjacent walls, doors, and obstructions.
- D. Selection Samples: For each finish product specified, color chips representing manufacturer's full range of available colors and patterns.

1.05 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide products by the same manufacturer.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least ten years of documented experience.
- C. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Handle racks with sufficient care to prevent scratches and other damage to the finish.

1.07 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals for additional warranty requirements.
- B. Manufacturer Warranty: Provide three-year manufacturer warranty for material and/or workmanship. Complete forms in District's name and register with manufacturer.
- C. Finish Warranty: Provide five-year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Complete forms in District's name and register with warrantor.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Basis of Design Product: FGP Bicycle Rack as manufactured by Landscape Forms, Inc., or approved equal.
- B. Exterior Bicycle Racks:
 - 1. Belson Outdoors: www.belson.com.
 - 2. Columbia Cascade Company: www.timberform.com.
 - 3. Dero: www.dero.com.
 - 4. Highland Products Group, LLC: www.indoorbikeracks.net.
 - 5. Huntco Supply, LLC: www.huntco.com.
 - 6. Landscape Forms, Inc.: www.landscapeforms.com.
 - 7. MADRAX, a brand of Graber Manufacturing, Inc: www.madrax.com/#sle.
 - 8. Neenah Foundry, a division of Neenah Enterprises, Inc: www.nfco.com.
 - 9. Substitutions: See Section 01 60 00 - Product Requirements.

2.02 BICYCLE RACKS

- A. Exterior Bicycle Racks: Device allows user-provided lock to simultaneously secure one wheel and part of the frame on each bicycle parked or racked.
 - 1. Style: Decorative.
 - a. FGP Frame: Alluminum Casting with matching front and back covers.
 - 2. Mounting, Ground: In-ground anchor.
 - 3. Finish: Powder coat, maintenance-free and weather-resistant.
 - 4. FGP Finish on upper frame: Clear anodized.
 - 5. FGP Finish on cover plates: Dark grey anodized.
 - 6. Color: As selected by Architect from manufacturer's custom range.
 - 7. Accessories: In-ground grout cover.
- B. Materials:
 - 1. FGP Aluminum Casting:
 - a. Anodized: AC7A or AL535 alloy.
 - b. Powder Coat: Use A360 Alloy.
 - 2. FGP Hardware:
 - a. Surface Mount: Two M4 x 0.7 x 12mm socket button head cap screws with Magni-coat secure the covers together.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine surfaces to receive bicycle racks.
- B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory conditions before proceeding.

- C. Do not begin installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

- A. Ensure surfaces to receive bicycle racks are clean, flat, and level.

3.03 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install level, plumb, square, and correctly located as indicated on drawings.
- C. In-Ground Anchor Installation:
 - 1. Prepare holes in size according to manufacturer's instructions.
 - 2. Place anchoring bolts through the holes in pipe.
 - 3. Lower rack into holes, ensuring the bottom of lower bends are at least 1-1/2 inch from the ground.
 - 4. Place concrete.
 - 5. Level rack before concrete sets.
 - 6. Support until dry.
- D. Post-Installed Anchors: Comply with ICC-ES AC308.
- E. Freestanding Installation: Place in location indicated on drawings.

3.04 CLEANING

- A. Clean installed work to like-new condition. Do not use cleaning materials or methods that could damage finish.

3.05 PROTECTION

- A. Protect installed products until completion of project.
- B. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

SECTION 32 80 00 LANDSCAPE IRRIGATION

PART 1 – GENERAL

1.01 SCOPE

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division I, Specification Sections apply to this Section.
- B. Includes furnishing all labor, materials, tools and equipment required to provide and install the irrigation system specified herein and required to complete the work per the Plans.
- C. Related work:
 - 1. Section 32 90 00 – Landscape Planting;
 - 2. Section 32 92 00 – Turf Sodding.

1.02 REQUIREMENTS OF REGULATORY AGENCIES

- A. Comply with all local and state codes, ordinances, safety orders, and regulations of all legally constituted authorities having jurisdiction over this work.
- B. Obtain and pay for all necessary permits and all inspections required by authorities stated above.
- C. Notify the Landscape Architect in the event any equipment or methods indicated on the Drawings or in the specifications conflict with local codes, prior to installation. In the event this notification is not performed, the Contractor must assume full responsibility for revisions necessary.

1.03 PROTECTION

- A. Contractor shall call DIG ALERT, ((1) (800) 642-2444), a minimum of 48 hours prior to any excavation.
- B. Contractor shall check for located existing structures, electric cables or conduits, utility lines and other existing features or conditions above or below ground level that might be damaged as a result of this operation. Questions or conflicts arising out of such examination prior to or during operation shall be immediately directed to the attention of the Landscape Architect for necessary action or decisions before resuming operations. Contractor shall be responsible for repair or replacement, at no cost to District, for features or condition damaged through failure to comply with above procedures.

1.04 SUBMITTALS

- A. Record Drawings: Maintain information daily. Keep updated drawings onsite at all times for review by the School District Representative(s).
1. The Contractor shall maintain on a daily basis a complete and accurate set of record drawings. These drawings must be kept up-to-date at all times with the progress of the work. The District shall furnish a set of drawings on which to record changed conditions.
 2. The Contractor shall indicate clearly all work installed differently from that shown on the contract drawings. By dimensioning from two permanent points of reference (building corner, sidewalk or road intersections), show connection to existing water lines, connection to existing electrical power, gate valves, pressure supply pipe, control valves, control wiring, automatic controller, quick coupler valves, sleeve locations, and other related equipment as directed by the District's representative.
 3. Use appropriate eradication methods for removing original lines and dimensions where changes are made. Completed reproducibles shall be equal to the original drawings. Mark record set(s) with red erasable pencil.
 4. Submit 14 days prior to final inspection, one set of marked-up Contract drawings.
 5. After approval, the Contractor shall obtain one (1) set of the contract drawings from the Landscape Architect, and all changes as noted on the redlined set shall be drawn on the new set with waterproof ink. The Contractor shall sign the transparencies as complete and accurate records of as-built work. This set of as-built drawings shall be delivered to the Landscape Architect for final approval, after which the Contractor shall make copies for the District, Landscape Architect, and other applicable parties.
- B. Controller Charts
1. Record drawings shall be approved by the Landscape Architect before charts are prepared.
 2. Provide one controller chart for each controller supplied.
 3. The chart shall show each area controlled by automatic controller and shall be the maximum size controller door will allow.
 4. The chart is to be a reduced drawing of the actual constructed system. However, in the event the controller sequence is not legible when the drawing is reduced, it shall be enlarged to a size that will be readable. This may involve providing more than one chart.
 5. The chart will be a blackline print and a different color shall be used to show area of coverage for each station.
 6. When completed and approved, the chart shall be hermetically sealed between

two pieces of plastic, each piece being a minimum of 20 mils thick.

7. The chart shall be mounted using Velcro, or an approved equal type of tape. If the controller door is constructed with a pre-manufactured pocket for the controller chart, the Velcro mounting may be omitted.
8. These charts shall be completed and approved prior to final inspection of the irrigation system.

C. Checklist

1. Provide a signed and dated checklist and deliver to the School District's Representative prior to final review of the work. Use the following format.
 - Confirmation of service pressure: psi., by whom and date.
 - Plumbing permits: if none required, so note.
 - Materials furnished: received by and date.
 - Material approvals: approved by and date
 - Pressure line tests: by whom and date
 - Record drawings: received by and date
 - Controller charts: received by and date
 - Operations and maintenance manuals: received by and date
 - System and equipment operation instructions: received by and date
 - Manufacturer's warranties, if required: received by and date
 - Written guarantee: received by and date
 - Lowering of heads in natural turf areas; if complete, state so.

D. Manufacturers Catalogs

1. Submit for approval, manufacturer's catalogs on all material to be used on the project (scanned/PDF). These catalogs are to be submitted 30 days prior to the start of any work.

E. Additional Submittals

1. For any submittals which necessitate additional research on the part of the Landscape Architect, to prove the product is acceptable, the Contractor will be charged on an hourly basis for this additional work.

F. Approvals and Rejections

1. Equipment or materials furnished or installed without prior approval of the District's representative may be rejected and the Contractor required to remove and replace such materials from the site at no cost to the District.

1.05 DRAWINGS

- A. For purposes of legibility, sprinkler lines are essentially diagrammatic. Although size

and location of irrigation equipment are drawn to scale wherever possible, the Contractor shall make use of all data in all of the contract documents and verify this information at construction site.

- B. Interpretations: Drawings and specifications are intended to be fully cooperative and to agree. However, if the Contractor observes that the drawings and specifications are in conflict, he shall promptly notify the Landscape Architect in writing (prior to bidding and/or construction). The specification calling for any higher quality material or workmanship shall prevail. Questions regarding interpretation of drawings and specifications shall be clarified by the Landscape Architect.

1.06 PERFORMANCE REQUIREMENTS

- A. Unless otherwise provided, irrigation system layout shown on the plan shall be considered schematic. With the Landscape Architect's approval, the Contractor may make adjustments where necessary to conform to actual field conditions. The irrigation system shall be operational, with uniform and adequate coverage of areas to be irrigated, prior to planting.
1. Utility connections shall be as shown on the plan or designated by the utility company. The Contractor shall include in his bid all costs for such utility connections shown on the plans or designated by the utility company.
- B. Water Supply
1. The sources of water supply shall be as indicated on the drawings as P.O.C., "Point of Connection".
- C. Contractor Responsibility
1. The Contractor shall ensure full coverage of the irrigation system and shall make all approved modifications necessary to accomplish full coverage.
2. Contractor shall not willfully install the plumbing or sprinkler system as indicated on the drawings when it is obvious in the field that there are obstructions, grade difference and/or discrepancies in area dimensions until such conditions are brought to the attention of the Landscape Architect.

1.07 PRE-CONSTRUCTION CONFERENCE

- A. The Contractor shall schedule with the Landscape Architect and Districts Representative a pre-construction conference at least seven (7) days before beginning work under this section. Purpose of this conference will be:
1. Review Contractor's questions regarding this project.
2. Review administrative and inspection procedures that will occur during construction.
3. Review Contractor's work schedule for this project.
4. Verification of Contractor's C-27 License, Bonding and Insurance.

PART 2 – PRODUCTS

2.01 GENERAL

- A. All irrigation equipment: shall be new and unused prior to installation; and shall conform to the Irrigation Plan, Legend and Specifications.
- B. Irrigation equipment, which has been damaged in any way, shall be replaced by the Contractor at no additional cost to the District. If equipment has already been installed, it shall be removed and replaced by the Contractor at no additional cost to District.

2.02 PLASTIC PIPE AND FITTINGS

A. Plastic Pipe

Shall be rigid, high impact, Type I, unplasticized polyvinyl chloride (PVC) extruded from virgin parent material Geon 8700A or Geon 8714. Contractor shall furnish for each shipment delivered, a statement from the manufacturer certifying use of virgin material only. The pipe shall be homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, deleterious wrinkles or dents and shall conform to the following dimensions and physical properties:

- 1. All plastic pipe shall be continuously and permanently marked with the manufacturer's name, kind of pipe, material size, IPS NFS approval, schedule and type, and date of extrusion.
- 2. Plastic pipe shall be as manufactured by Lasco, Celanese, Pacific Western, John Manville, Brownline, Inc. or approved equal.

B. Main Line

- 1. Piping on the pressure side of irrigation control valves ($\leq 4''$) to be PVC Class 315, meeting ASTM-D2241, Type I, Grade I PVC-1120 Cell Class 12454-B specifications.

C. Lateral Lines

- 1. Piping under intermittent pressure shall be PVC 1120-1220, Type 1, Grade 1, Sch.40 and shall conform to ASTM D1785.

D. Control Wire Conduit

- 1. Plastic pipe used as conduit for 24v. direct burial wire shall be PVC 1120-1220, Sch.40 and shall conform to ASTM D1785 (use gray Sch.80 wherever conduit is exposed, and sweep ells at all corners, above and below grade).

E. Fittings and Connections

1. Plastic PVC slip fittings shall be standard weight Schedule 40 (2" & smaller) and Schedule 80 (2.5" and larger) to meet ASTM D2466-73 and D2467-73.
2. All threaded nipples and fittings shall be standard weight Schedule 80 to meet ASTM 80 D2466-73 and D2467-73.
3. Polyethylene drip system connection shall be RIS 5/8" insert or compression type fittings.

F. Drip Line

Tubing under 30 lbs. pressure shall be RIS Dura-pole non-cross link low-density polyethylene hose, 16 mm (5/8", or larger if specified).

2.03 GALVANIZED PIPE AND FITTINGS

- A. Where indicated on the drawings, use galvanized steel pipe ASA Schedule 40 mild steel screwed pipe.
- B. Fittings shall be medium galvanized screwed beaded malleable iron. Galvanized couplings may be a merchant coupling.

2.04 WATER METERS

- A. Existing to remain.

2.05 BACKFLOW PREVENTION

- A. Backflow preventer shall be as designated on the plans and in the irrigation legend.

2.06 SLEEVE MATERIAL

- A. For control wires: PVC Schedule 40 (of sufficient diameter for ease of pulling, with minimum 50% expansion area).
- B. For water lines: PVC Schedule 40 (minimum 2 times line diameter).
- C. For drip tubing: PVC Schedule 40 (minimum 2 times line diameter).

2.07 AUTOMATIC CONTROLLER

- A. Existing to be reinstalled in a strongbox as noted on the plans. The contractor is to purchase and install the strongbox pedestals-@@@ Top Entry SS Contr. Enclosure (24Wx17Dx38H) with KTS CSA52 52 -Sta Controller Sub Assy (Term Strip etc) Sub assembly for a 40 Site Sat, Include a Rainbird PT322 Pulse Transmitter. Purchased from Kern Turf Supply INC. (661) 833-0596 contact Vinny Osborn vosborn@kerntrufsupply.com

2.08 CONTROL WIRING

- A. Connections between the automatic controllers and the electric control valves shall be made with direct burial wire AWG - U.F. No.14-600 volt (use No.12-600v. for all valves farther than 1000 feet from controller, and/or where specified on the plans). Install in accordance with valve manufacturer's specifications.
1. Waterproof dry-splice connectors shall be 3M #DBR/Y-6 or approved equal.
 2. Common wires (use No.12-600v.) shall be white in color with a different color stripe for each controller.
 3. Pump start/master valve wires shall be No.12-600v. continuous from controller to pump.
 4. Flow sensor wires shall be communication cable as recommended by the flow sensor / controller manufacturers.
 5. For flow monitoring, with a flow sensor installed, Station #2 is programmed and used as activation circuit for a normally-open master valve instead of a regular station valve.
 6. For flow monitoring utilizing multiple controllers, a flow sensor isolation device shall be installed. Isolation device shall be Creative Sensor Technology ISO6 or approved equal.
 7. For flow monitoring utilizing multiple controllers, install a second set of com. cable to be used for secondary 24 v. power to isolation device (ISO6).
 8. For flow monitoring utilizing multiple controllers, a master valve isolation device shall be installed. Isolation device shall be Tyco industries or approved equal.

2.09 TRACER WIRES

- A. No.12 Green Type TW plastic-coated copper tracer wire shall be installed with all non-metallic mainlines.

2.10 ELECTRIC CONTROL VALVES

- A. All electric control valves shall be as noted on plans and installed per details and manufacturer's specifications. Locate all valves in shrub areas unless otherwise noted.
- B. Provide one valve box for each remote control valve.

2.11 BALL VALVES

- A. Ball valves shall be as indicated on the drawings and installed per the details and manufacturers recommendations.

2.12 VALVE BOXES

- A. Quick Coupler Valves: NDS Pro-Spec Series (10" round). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install ½" above grade in turf areas (only where specified). Use 10" diameter PVC pipe for extension. The cover shall be heat branded with letters QCV, 2" high.
- B. Control Valves, Ball and Gate Valves (2" and smaller): NDS Pro-Spec Series (13"x24"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install ½" above grade in turf areas (only where specified). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the valve number, 2" high (for ball and gate valves brand "IRG").
- C. Control Valves, Ball and Gate Valves (2.5" and larger): NDS Pro-Spec Series (17"x30"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install ½" above grade in turf areas (only where specified). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the valve number, 2" high (for ball and gate valves brand "IRG").
- D. Control Wire Splice Boxes, Flow Sensor, Master Valve: NDS Pro-Spec Series (13"x20"). Locate 12" max. from walks/parallel walks, 3" above grade in shrub areas (top of box flush with top of bark). Install 1" above grade in shrub areas without bark mulch. Install ½" above grade in turf areas (only where specified). Provide and install lock bolt at the end of the maintenance period. The cover shall be heat branded with the letters IRG, 2" high.
- E. Traffic rated valve boxes: Christy Concrete #F8 with #F-8D lid (9"x12") for quick coupler valves; #B-30 with #B-30D lid (13"x24") for control valves 2" and smaller; and #B-36 with #B-36D lid (17"x30") for 3"- 4" control valves. Boxes shall be set flush with finish surface (paved areas) and flush with top of bark mulch in planter areas. Paint concrete lids with 2" high lettering and/or numbers as noted above.
- F. Screen for rodent protection shall be 16-gauge galvanized (1/2" x 1/2" openings), placed at base of box extension (above soil and below gravel).

2.13 QUICK COUPLING VALVES

- A. Quick coupling valves shall have a brass body with locking cover as indicated on the drawings.

2.14 SWING JOINTS

- A. Pre-manufactured triple-swing assemblies shall be Rainbird SA series, KBI TSA-TT series, or approved equal (12" length. Match sprinkler inlet size).

2.15 SPRINKLER HEADS AND DRIP EMITTERS

- A. Sprinkler heads shall be as designated on the plans and in the irrigation legend.
- B. Sprinkler heads on the same valve shall deliver matched precipitation and shall be of the same type, size and manufacturer.
- C. Minimum pop-up height: 6" height.
- D. Drip Emitters: As specified on drawings or in the irrigation legend.

2.16 PRESSURE REGULATION

- A. Pressure regulator shall be as designated on the drawings with output psi as specified.

2.17 SWING CHECK VALVES

- A. Swing check valves shall be made of high-impact Sch.40 PVC Type II with reinforced poppet. Install per manufacturer's recommendations.

2.18 SPRING CHECK VALVES

- A. Mainline and lateral line spring check valves shall be made of high-impact Sch.40 PVC Type II with reinforced poppet (1/4 lb. spring).

2.19 SOLVENT CEMENT

- A. Solvent cement used for bonding rigid PVC pipe and fittings up to 12" size shall be Weld-On #711 as manufactured by IPS Corporation or an approved equal. Primer for Weld-On #711 shall be Weld-On P-70 as manufactured by IPS Corporation or an approved equal.

2.20 MATERIALS TO BE FURNISHED

- A. Prior to final inspection furnish the following materials to the District:
 - 1. One key for each five quick coupler valves (one min.) with bronze garden hose bib;
 - 2. Two sets of special tools required for removing, disassembling, and/or adjusting each type of sprinkler and valve supplied on the project;
 - 3. As-built drawings;
 - 4. Colored sectioning chart;
 - 5. Contractors guarantee form

PART 3 – EXECUTION

3.01 SITE CONDITIONS

- A. Before starting work on the irrigation system, carefully check all dimensions and grades to determine that work may safely proceed, keeping within the specified material depths.

- B. Do not willfully install the irrigation system as indicated on the drawings when it is obvious in the field that unknown obstructions or grade differences exist, that might not have been considered in the engineering. Such obstructions or differences shall be immediately brought to the attention of the Landscape Architect.
- C. The installation of all irrigation materials, including pipe shall be coordinated with the landscape drawings to avoid interfering with the trees, shrubs, or other plantings.
- D. Layout irrigation heads and make minor adjustments required due to differences between site and drawings. Any such deviations in layout shall be within the intent of the original drawings, and without additional cost to the District. When directed by the Landscape Architect, the layout shall be approved before installation.
- E. Manufacturer's requirements for installation of products shall apply when;
 - 1. No other direction is given;
 - 2. It is a more stringent requirement than the Standard Specifications and these special provisions.
- F. Work Space:
 - 1. The Contractor shall erect fences and/or retain guards as required for the protection of the public and construction materials, and maintain same in good repair until the completion of the work under the contract.
- G. Drawings of Record
 - 1. Keep record drawings on site daily for observation by the School District Representative. All dimensions shall be taken and recorded prior to backfill. On the date of the final observation, deliver corrected drawings to the School District Representative. Final drawings shall be prepared by the Contractor on new prints obtained from the School District's Representative, showing all field notes in India ink and finalized by a competent draftsman. Delivery of prints does not relieve the Contractor of responsibility for providing any information that may have been omitted from the prints.

3.02 PIPE AND CONTROL WIRE INSTALLATION

- A. Trenching
 - 1. Dig trenches straight and support pipe continuously on bottom of ditch. Shade pipe in trench to an even grade. Trenching excavation shall follow layout indicated on drawings and as noted. Where lines occur under paved areas, these dimensions shall be considered below subgrade.
 - 2. Provide minimum cover of 24-30 inches from top of pipe to finish grade for all pressure supply lines.

3. Provide minimum cover of 24-30 inches from top of pipe to finish grade for all control wires.
4. Provide minimum cover of 12 inches from top of pipe to finish grade for all non-pressure lines.
5. All lines under driveway and roadway pavement shall have a 24-30 inch minimum cover.
6. Provide minimum cover of 18 inches from top of pipe to finish grade for non-pressure lines with 12 inch pop-up sprinkler heads.

B. Cutting and Patching

1. If cutting or breaking of any paving is necessary, it shall be done and replaced with like materials, at the Contractor's expense. Paving work shall match the original work in every respect, including type, strength, texture and finish. Obtain approval from the School District's Representative prior to any cutting and/or breaking. Hydraulic driving will not be permitted under asphalt paving. All sleeves set in place under paving shall extend 18" minimum beyond such paving and be capped hand tight. No fittings, including couplings, will be permitted under surfaces to be paved except where length of the line under the paving exceeds 20-feet and/or where the lines are encased in sleeves.
2. In new paved areas, coordinate installation of piping and wires under paving with the General Contractor.

C. Backfilling

1. Backfill shall not be placed until the installed sprinkler irrigation system has been inspected, tested, and approved by the Landscape Architect and Project Inspector. Trenches shall be backfilled promptly after the open trench inspection.
2. Backfill for trenching consisting of earth, loam, sandy clay, or other approved materials shall be compacted to a dry density equal to the adjacent undisturbed soil, and shall conform to the adjacent grades without dips, sunken areas, humps or other irregularities. Initial backfill on all lines (bottom 3") shall be of a fine granular material with no foreign matter larger than 1/2 inch size.
3. Irrigation lines under paving shall be backfilled with a 3" sand layer below the pipe and a 3" layer above, compacted in layers to 95% relative density, using mechanical tamping devices only. The remaining backfill shall be per Section 02200 and the Geotechnical Engineer's recommendations. Compact trenches equal to the compaction of the existing adjacent undisturbed soil and leave in a firm unyielding condition. Leave trenches flush with the adjoining grade.
4. All sand backfill shall terminate 3 feet from end of trench prior to building complex (backfill last 3 feet of all trenches with 50-50 clay/bentonite mix to prevent water migration next to buildings).

D. Water Supply

1. Connections to existing outlets shall be at the approximate location (s) shown on the drawings and indicated by P.O.C. "Point of Connection".

E. Pipe Fittings and Controls

1. Plastic to Plastic Fittings

- a. All plastic threaded pipe and fittings shall be assembled using Teflon tape or equivalent, applied to the male threads only.
- b. All plastic slip fittings shall be solvent welded as per pipe manufacturer's recommendations. Thoroughly clean PVC pipe and fittings of dirt, dust, and moisture prior to gluing.
- c. Slip-fix and/or compression fittings shall not be used to repair line breaks.

2. Plastic to Steel Fittings

- a. Male thread plastic into female thread steel shall be used.
- b. Work the steel connection first. A non-hardening pipe dope shall be used on threaded plastic-to-metal joints.

3. Galvanized Steel Pipe and Fittings

- a. Galvanized pipe threads shall be cut with clean, sharp dies conforming to ASA Specification B-2.
- b. Threaded joints shall be made up with the best quality pure joint compound or lead paste (on the male threads only) throughout the system.
- c. Any leaky joints shall be remade with new material. Use of thread cement or caulking to make joints tight will not be permitted.
- d. Galvanized pipe in contact with the soil shall be wrapped with 20 mil black PVC tape.

F. Line Clearance

1. All lines shall have a minimum clearance of 3 inches from each other, and 12 inches from lines of other trades. Parallel lines shall not be installed directly over one another.

G. Control Wires

1. Wiring shall occupy the same trench and shall be installed along the same route as pressure supply or lateral lines wherever possible. Place wire under water lines.
2. Where more than one (1) wire is placed in a trench, the wiring shall be taped together at intervals of ten (10) feet. Tape to the bottom of the mainline at ten-foot intervals where in common trench. Common and lead wires shall be a different color, with the same color being carried throughout from controller to valve.
3. An expansion curl shall be provided within three (3) feet of each wire connection and at least every one hundred (100) feet in length. Expansion curls shall be formed by wrapping at least five (5) turns of wire around a one-inch pipe (or more) in diameter, then withdrawing pipe.
4. Splices shall be made with 3M waterproof connectors or equal, and done in valve boxes or pull boxes only.
5. Provide one additional wire between the controller and the furthest valve in each direction (north, south, east, and west) as a minimum (4 extra wires possible), unless shown differently on the irrigation plans.
6. If wires under paved areas cannot be continuous, all splices shall be enclosed in an approved box.
7. Tracer wire shall be placed on the bottom of the trench, under the pipe. Wire shall be continuous length throughout the length of the pipe. All splices shall be soldered at joints and covered with exterior wire insulation tape, manufactured for this purpose. Tracer wire shall follow the mainline and branch line and terminate in an irrigation valve box. Provide enough length of wire to reach the surface grade, plus 24". Bend wire to create a loop and attach an approved label with the designation of "Tracer Wire".

H. Thrust Blocks

1. All lines larger than 1-1/2" shall receive concrete thrust blocks at all corners, tees, elbows, and end caps. Use a minimum of 1/2 c.f. of concrete per diameter inch of pipe (i.e. 2" pipe = 1 c.f. concrete). Do not encase pipe or fittings!

I. Sleeving

1. All lines under paving (concrete and asphalt) shall be sleeved. Sleeves shall be installed in straight runs from planter to planter. Install (pre-pipe) lines in sleeves for future connections at the time of sleeving installation. Sleeves and lines shall extend a minimum of 18" beyond any existing and/or future hardscape.
2. All control wires under paving (concrete and asphalt) shall be sleeved (use sweep ells at all corners). Install a nylon pull cord in sleeving for all wire pulls.

J. Flushing the System

1. After new irrigation pipe lines and risers are in place and connected, all necessary division work has been completed, and prior to installation of sprinkler heads, the control valves shall be opened and a full head of water used to flush out the system.

3.03 ELECTRIC CONTROL VALVES

- A. Install as indicated on the drawings.
- B. Install each valve in a separate valve box.
- C. When grouped together, allow at least 6 inches between valve boxes.
- D. Attach identification tags to each remote control valve, indicating number that corresponds with controller station number.

3.04 SPRINKLERS HEADS & DRIP EMITTERS

- A. Install heads as indicated on plans and details. Adjust locations of heads to accommodate site conditions and to provide full coverage.
- B. Use hole punch or power drive for emitter holes in polyethylene drip tubing. Prevent penetrating both walls of pipe. Insert barb firmly in pipe until barb completely penetrates one wall of tubing.

3.05 DRIP TUBING

- A. Drip tubing shall be installed parallel with elevation contours on slopes where applicable. Install in long, straight runs, continuing over dips and humps, and other minor changes in elevation.
- B. Tubing shall be staked 36" on center with 10" long (min.) jute staples.
- C. Maximum gallons per minute flow (gpm) through polyethylene tubing shall be as follows: 5/8" = 4 gpm.

Systems shown on the irrigation plans which specify gallonage greater than 4 gpm shall be modified to use larger diameter tubing or manifolded so that each 5/8" lateral does not exceed 4 gpm flow.

3.06 ADJUSTING OF SYSTEM

- A. Adjust the control valve to obtain the design rated pressure for the sprinklers installed.
- B. Set all flow-controls on the control valves in the system to the full open position minus 2

turns.

- C. Adjust all irrigation heads in each section for equal height sprays, and minimum over spray on walks, buildings and windows.
- D. If it is determined that adjustments in the irrigation equipment or nozzle changes will provide proper and more adequate coverage, make necessary changes without additional cost to District, prior to planting. Adjustments may also include changes in nozzle sizes and degrees of arc as required.
- E. The entire system shall be operating properly before any planting operations commence.

3.07 EXISTING TREES

- A. Where it is necessary to excavate adjacent to existing trees, use all care possible to avoid injury to trees and tree roots. Where root diameter exceeds 2 inches, excavate by hand. Tunnel under roots 2 inches and larger in diameter (wrap root with wet burlap to prevent excessive drying while the trench is open). Where a ditching machine is run close to trees having roots smaller than 2 inches in diameter, hand-trim the wall of the trench adjacent to the tree, making clean cuts through. Paint roots 1 inch and larger in diameter with 2 coats of Tree Seal, or equal. Close trenches adjacent to tree within 24 hours; and where that is not possible, shade the side of the trench adjacent to the tree with burlap or canvas.

3.08 INSPECTION AND TESTING

- A. General
 - 1. In no event cover up any work prior to approval of the Landscape Architect. Any work covered prior to inspection shall be opened to view by the Contractor at his expense. Re-examination of questionable work may be ordered by Landscape Architect, and if so ordered, any work must be uncovered by Contractor. If the work is not in accordance with the drawings and specifications, Contractor shall pay the costs of re-examination and replacement.
 - 2. When observations have been conducted by other than the Landscape Architect, submit documentation showing when and by whom these observations were made.
 - 3. No site inspections shall occur without updated record drawings.
 - 4. All observations called for by the Contractor shall be requested in writing at least seven (7) days prior to the anticipated observation.
 - 5. Contractor shall provide "walkie-talkie" equipment and/or personnel to maintain communication from the review area to the automatic controller(s).
 - 6. In the event the Contractor has scheduled an inspection, and the specified work is not completed or deficient, the Contractor shall pay all costs involved for re-examination.

B. Pressure Testing - All mainlines; (and lateral lines under paving)

1. As soon as lines are connected and flushed-out (and prior to attaching valves), cap all outlets and hydrostatically test at 150 psi for a continuous twenty-four (24) hour period, at the end of which the lines and joints shall be inspected by the Landscape Architect and or the Project Inspector (locate pressure gauge at the center of mainline system and shut off water point of connection). The Contractor shall furnish all pumping and test equipment. If leaks develop, the pipe and/or joints shall be replaced and the tests repeated in the presence of the Project Inspector until all leaks are repaired (allowable 5-psi drop in 24-hour period. Pressure must stabilize at max. 5-psi drop).

C. Operation Testing

1. Prior to planting, the entire irrigation system shall be placed in automatic operation and tested in the presence of the Landscape Architect for proper functioning and coverage. If it is determined that adjustments in the irrigation equipment or nozzle changes will provide proper and more adequate coverage, make necessary changes without additional cost to District, prior to planting. Adjustments may also include changes in nozzle sizes and degrees or arc as required.

3.09 CLEAN UP AND REPAIR

- A. Upon completion of the work, make the surface level, remove excess materials, rubbish debris, and remove construction and installation equipment from the premises.
- B. Replace and/or repair to the satisfaction of Landscape Architect existing paving disturbed during the course of work. New paving shall be the same type, texture, finish and be equal in every way to the material removed.

3.10 PRE-MAINTENANCE ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work. Upon pre-maintenance acceptance, the Landscape Architect will give written notification to commence 90-day maintenance period.

3.11 MAINTENANCE

- A. The entire irrigation system shall be maintained for a period of 90-days following the date of pre-maintenance acceptance of the work. System shall be in good working order at the end of the maintenance period.
- B. Landscape Contractor shall be responsible for any and all damage and/or vandalism to the irrigation system, which may occur during the maintenance period or the course of work (regardless of fault). Make all repairs and provide all replacement materials and labor to the satisfaction of the District.

3.12 FINAL ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work (including maintenance). Upon final acceptance and written notification, the District will assume responsibility for maintenance of the work.

3.13 GUARANTEE

- a. The entire irrigation system shall be guaranteed by the Contractor as to materials and workmanship, including settling of backfilled areas for a period of one (1) year following the date of final acceptance of the work. Guarantee shall also cover damage to any part of the premises resulting from leaks or other defects in, materials, equipment, and workmanship to the satisfaction of the District.
- b. A guarantee form shall be re-typed in the following onto the Contractor's letterhead and contain the following information:

"GUARANTEE FOR THE IRRIGATION SYSTEM"

We hereby guarantee that the irrigation system we have furnished and installed is free and clear from defects in materials and workmanship, and the work has been completed in accordance with the Drawings and Specifications. We agree to repair and/or replace all defects in material or workmanship which may develop during the period of one-year of acceptance and also to repair and/or replace all damages resulting from the repair of such defects at no additional cost to the School District, after receipt of written notice. In the event of our failure to make repairs or replacements within a reasonable amount of time after receipt of written notice, we authorize the School district to proceed to have said repairs and/or replacements made at our expense, and we will pay the costs and charges therefore upon demand.

Project: _____

Location: _____

Contractor/Company: _____

License Number: _____

Address: _____

Office Phone: _____

Cell Phone: _____

FAX: _____

E-mail: _____

Date of Final: _____

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

Acceptance: _____

Signed: _____ Date: _____

END OF SECTION

SECTION 32 90 00 LANDSCAPE PLANTING

PART 1 - GENERAL

1.01 SCOPE

- A. Provide all labor, materials, equipment and services to complete the finish grading, planting, maintenance of planting and related items, as indicated on the drawings and specified herein, providing landscaping with plants in vigorous growth condition, ready for the Owner's use.
- B. Related work specified elsewhere includes but may not be limited to:
 - 1. Section 32 80 00 – Landscape Irrigation;
 - 2. Section 32 92 00 – Turf Sodding.
- C. Sample:
 - 1. Decomposed Granite: Submit a product sample (approximately 2 lb. quantity) of the decomposed granite to be installed for this project. The sample must be submitted and approved by the Landscape Architect prior to ordering and/or installation.

1.02 SUBMITTALS

- A. Furnish original material invoices and original truck delivery tickets indicating the quantities of fertilizers and soil amendments delivered to the job site. Material invoices must be approved by the Landscape Architect prior to installation. Photocopies will not be accepted and the Landscape Architect must be on site to verify all deliveries.
- B. Furnish material invoices or documentation to the Landscape Architect at least 30 days prior to start of work indicating that all plant material has been ordered.

1.03 PROTECTION

- A. Contractor shall check for location of cables or conduits, utility lines and other existing features or conditions above or below ground level that might be damaged as a result of his/her operation. Questions or conflicts arising out of such examination prior to or during operation shall be immediately directed to the attention of the Landscape Architect for necessary action or decisions before resuming operation. Contractor shall be responsible for repair or replacement, at no cost to the Owner, for features or conditions damaged through failure to comply with above procedures.

1.04 ALTERNATES

- A. Alternates will not be permitted unless authorized by the Landscape Architect at least 30 days prior to start of work. The Landscape Architect will assist the Contractor in the selection of the nearest equivalent size and variety of plant.

1.05 DRAWINGS

- A. Interpretations: Drawings and specifications are intended to be fully cooperative and to agree. However, if the Contractor observes that the drawings and specifications are in conflict, (s)he shall promptly notify the Landscape Architect in writing (prior to bidding and/or construction). The specification calling for any higher quality material or workmanship shall prevail. Questions regarding interpretation of drawings and specifications shall be clarified by the Landscape Architect.

1.06 INSPECTIONS

- A. The Contractor shall notify the Landscape Architect 24 hours in advance of all soil preparation, planting and maintenance inspections.
- B. The Contractor shall schedule with the Landscape Architect a preconstruction conference at least 7 days before beginning work under this section. The purpose of this conference will include:
1. Review of Contractor's questions regarding this project;
 2. Review administrative and inspection procedures that will occur during construction;
 3. Review the Contractor's work schedule for this project;
 4. Verification of Contractor's C-27 License, Bonding and Insurance.
- C. Fine Grading and Soil Preparation
1. Furnish certificates for soil amendments at this time (per Section 1.02);
 2. The fine grading and soil preparation of all planted areas must be approved prior to installation of plant material.
- D. Plant Material
1. Plant material quality will be inspected prior to planting. Plants that are found to be rootbound, of insufficient size, or of irregular shape may be rejected by the Landscape Architect. Rejected plants will be replaced at no extra expense to the Owner.
 2. The Contractor will field locate all box and container stock before planting. The Landscape Architect will then be allowed to adjust the locations of any plant materials prior to installation.
- E. Pre-Maintenance Inspection
1. The pre-maintenance inspection will occur after all work has been completed as indicated on the drawings and in the specifications. If approved, this will be the starting date of the 90 day maintenance period.
- F. Final Inspection
1. The final inspection will occur after the 90 day maintenance period and all work is completed. If approved, this will be the date of final acceptance.

1.07 GUARANTEE AND REPLACEMENT

- A. All specimen trees in 24 inch box and larger shall be guaranteed for one (1) full year; all 15 gallon plants for one (1) year; all 1 gallon and 5 gallon plants for six (6) months; lawns for three (3) months; 4"5½" pots and flatted groundcover for 60 days, from date of final acceptance.
- B. The Contractor shall replace all dead plants and all plants not in a vigorous, thriving condition as determined by the Landscape Architect during and at the end of the guarantee period. Replacement plants shall be of the same quality as the original specified plants.
- C. Landscape Contractor shall be responsible for any and all damage and/or vandalism to planting which may occur during the maintenance period or the course of work (regardless of fault). Make all repairs and provide all replacement materials and labor to the satisfaction of the Owner.

PART 2 - MATERIALS

2.01 PLANT MATERIAL

- A. Plants shall be grown in nurseries inspected by the State Department of Agriculture. Plants shall be grown in accordance with good horticultural practices under climatic conditions similar to those of the project.
- B. Plants shall be fresh, well-established, vigorous, of normal habit of growth, free of disease, insects, insect eggs and larvae. Plants shall be healthy, with a normal root system, well filling their containers, but not to the point of being rootbound.
- C. The height and spread of all plant material shall be measured with branches in their normal position when plant is installed. Multi-trunked trees, as noted on the drawings, shall mean trees with three or more trunks and all trunks shall be equal in caliper. All multi-trunked trees shall be true multis. Made up multis where 3 separate plants are grown together are not acceptable.
- D. Pruning shall not be done prior to inspection.
- E. The size of plants shall conform to the plan or the plant list. Oversized plants may be used at no additional cost to the Owner. Plants shall be well rooted in their containers. Rootbound plants and plants with poorly formed root systems, as a result of a recent shift in container size, will not be accepted.
- F. Tree trunk calipers and taper shall be sufficient so that the tree will remain vertical without a stake. Trunk caliper at 6 inches above the soil media (substrate) surface shall be within the diameter range shown for each container size below:

<u>Container Size -----Trunk Diameter</u>	
5 gal.....	0.50" to 0.75"
15 gal.....	0.75" to 1.50"
24-inch box.....	1.50" to 2.50"

2.02 TOPSOIL (IF REQUIRED FOR IMPORT)

- A. Topsoil shall be fertile, friable, sandy loam free from weeds and seeds per USDA 7th approximation classification method. Acceptable soil from the site may be used. Should topsoil be imported, an agricultural suitability test shall be conducted by an approved soils laboratory and results submitted to the Landscape Architect for approval prior to delivery to job site.
- B. Identify source location, percentages of silt, clay, sand, organic matter, pH, mineral and plant nutrient content of soil. Particle size shall fall within the following desired range:

Clay and silt, 20% - 50%; fine sand, 30% - 40%; coarse sand, 5% - 20%; gravel (maximum aggregate size 3/4"), 0% - 8%; decomposed organic matter, 2% - 50%. All sandy loam must pass through a one-inch sieve. The sand fraction shall have 85% falling within the medium to fine sand range. Soils unsuitable for planting shall be rejected.

- C. Provide soils analysis expressed in parts per million including the following:

Organic content; nitrogen; phosphorous; potassium; magnesium; calcium; sodium; sulfur; zinc; manganese; copper; iron; boron; pH; ammonium; sodium absorption rate (SAR); ECe; and USDA particle size.

- D. Suitability of soil and chemical deficiencies will be determined by Landscape Architect (Landscape Architect may submit a list of what additives should be installed to correct these problems). Soils deemed unsuitable for planting shall be rejected.

2.03 SOIL AMENDMENT

- A. Pre-plant fertilizer shall consist of Live Earth Humate Soil Conditioner + Gyp and Live Earth First Green 5-3-1 fertilizer. Retain all bags for inspection by Landscape Architect prior to disposal.
- B. Top-dress fertilizer shall consist of Live Earth First Green 5-3-1 fertilizer on turf areas; Live Earth Humate Soil Conditioner + Gyp and Live Earth First Green 5-3-1 fertilizer on flatted groundcover areas; Flower 'N' Bloom 3-12-12 Fertilizer on 4"/5½" pot areas. Retain all bags for inspection by Landscape Architect prior to disposal.
- C. Tree and shrub fertilizer shall consist of Best "Best-Paks" 20-10-5 fertilizer packets, used with the backfill of every plant as follows:
 - 1. 4"/5½" pot - 1 packet;
 - 2. 1 gallon - 1 packet;
 - 3. 5 gallon - 3 packets;
 - 4. 15 gallon - 9 packets;
 - 5. Box plants - 1 packet per every 2" of box size.
- D. Organic amendment shall consist of nitrolized redwood sawdust. Submit sample and analysis to Landscape Architect for approval prior to delivery to site.
 - 1. Nitrogen stabilized: .4 - .6% N (dry weight for redwood sawdust), .56 - .84% N (dry weight for fir or cedar), .8 - 1.2% N (dry weight for fir or pine).

2. Particle size: 95 - 100% passing 6.35mm standard sieve, 80 - 100% passing 2.33mm standard sieve.
3. Salinity: Saturation extract conductivity shall not exceed 3.5 millimhos/centimeter at 25 degrees centigrade.

E. Gypsum shall be powdered calcium sulfate (clay soil only).

2.04 MIXES

- A. Backfill mix for each plant shall consist of 6 parts native soil (or approved imported soil), 4 parts nitrolized organic amendment, Live Earth Humate Soil Conditioner + Gyp and Live Earth First Green 5-3-1 fertilizer (18 lbs./c.y. fill), Agricultural Gypsum (15 lbs./c.y. fill) if clay soil, and "Best-Paks" fertilizer packets as noted.

2.05 MULCH

- A. Planter Basin/Shrub Area Mulch: "Gorilla hair" bark mulch, free of sticks, dirt, dust or other debris (KEEP 2" MINIMUM FROM BARK OF PLANT).

2.06 HERBICIDE

- A. Post-emergence (existing weeds): "Roundup" or equal/approved.
- B. Pre-emergence (non-turf areas only, prior to seed germination): "Ronstar" or equal/approved.
- C. Post-emergence (turf areas only): "Ortho Weed-B-Gon" or equal/approved.

2.07 DEEP ROOT PLANTERS

- A. All trees planted within 7½ feet of paving or curbing, or in tree wells, shall have deep root planters.
- B. Deep root planters shall be Deep Root Corporation Model "UB 18-2" for 15 gallon trees, Model "UB 24-2" for 24" box trees or equivalent (high-density polyethylene). Install per manufacturer's instructions.

2.08 CONCRETE MOW STRIP

- A. Concrete mow strip shall comply with details on the plan.

2.09 DECOMPOSED GRANITE

- A. Decomposed granite shall be tan colored "pit sand", or approved equal (with stabilizer), and shall be clean and free from clay or organic materials and shall be of such nature that it can be readily compacted under watering and rolling to form a firm stable base.

PART 3 - EXECUTION

3.01 SOIL PREPARATION

- A. Remove from all planted areas rocks over 1 inch diameter, sticks and other debris, weeds and foreign growth of any kind.
- B. In the event actively growing common bermuda grass or bermuda stolens are encountered, an "irrigation - germination - weed eradication" program shall be performed until all non-specified plant material has been removed. Upon acceptance of irrigation system by the Landscape Architect, Contractor shall apply sufficient amounts of irrigation water to initiate germination of any and/or all non-specified seeds. The "irrigation - germination - weed eradication" program shall be performed a minimum of two (2) times or until all non-specified plant material has been removed. Contractor shall use a "post-emergence weed killer": "Roundup" or approved equal.
- C. Contractor shall chemically eradicate all germinated weed seeds. (See Section 2.06 Herbicide A. Post-emergence.)
- D. To all planted areas apply the following per 1000 s.f. and till into the top 6" of soil:
 - 1. 50 lbs. Live Earth Humate Soil Conditioner + Gyp;
 - 2. 100 lbs. Live Earth First Green 5-3-1 fertilizer;
 - 3. 4 cubic yards of organic amendment.

3.02 FINISH (FINE) GRADING

- A. No plant materials shall be installed until all operations in conjunction with the installation of the irrigation system have been completed, finish grades have been established and planting areas have been properly prepared and graded.
- B. Finish grading operations shall include establishment and/or re-establishment of all surface drainage patterns, as indicated on the grading and drainage plans. All areas shall have a uniform gradient, with no abrupt changes and/or undulations. All low-spots shall be filled to establish positive drainage to appropriate drainage facilities.
- C. Finish grade includes, but is not limited to, the removal of all foreign material of any kind, 1" and larger, within the top 6" of the soil surface.
- D. Establish finish grade for hydroseeded turf areas 1" (sodded turf areas 1½") below header board, edging, mow strips and/or adjacent pavement areas.
- E. Establish finish grade for planting areas 3" below header board, edging, mow strips and/or adjacent pavement in areas to receive minimum 2" layer of mulch.
- F. Establish finish grade for planting areas 1" below header board, edging, mow strips and/or adjacent pavement in 4" / 5½" pot and flatted groundcover areas to receive minimum 1" layer of mulch.

- G. All areas shall be compacted with a water-filled roller to provide a smooth finish surface. Final compaction shall range between 85% for level areas, and up to 90% for 2:1 slopes.
- H. All finish grades shall be completed and accepted by the Landscape Architect prior to any planting, sodding and/or hydroseeding operations.

3.03 PLANTING - TREES AND SHRUBS

- A. Trees and shrubs shall be set in the field in locations shown on the drawings. All planting locations shall be approved or adjusted as necessary by the Landscape Architect before planting holes are excavated.
- B. Tree and shrub planting shall comply with details on the plan.
- C. Excavate pits of circular outline with vertical sides for all plants. Scarify sides and bottoms of all plant pits.
- D. After removing plant from container, make several 1" deep vertical cuts along the root ball to scarify it to prevent root bound conditions. Protect roots or balls of plants at all times from sun and drying winds.
- E. Use backfill mix to backfill plant pits (thoroughly mix prior to use). Set plants plumb and brace rigidly in position until planting soil has been tamped solidly around the ball and roots. When plant pits have been backfilled approximately 2/3 full, water thoroughly, saturating rootball, before installing remainder of the planting soil to top of pit, eliminating all air pockets.
- F. Place "Best-Paks" fertilizer packets evenly distributed in plant pits when backfilled 2/3 according to the schedule specified.
- G. Stake plants in accordance with the details on the plans. Stakes shall not interfere with the root ball area. Stake immediately after planting. Plants shall be plumb after staking. Stakes and ties shall be adjusted to prevent girdling and chafing and shall be removed as soon as trees show signs of inherent stability.
- H. If directed by the Landscape Architect, the Contractor shall prune plants in accordance with standard horticultural practice. Cuts over 1/2" in diameter shall be painted with approved tree paint.
- I. Form water wells around tree and shrub pits according to details on plans. NOTE: *Do not form basins in turf areas.*
- J. Mulch all water wells with a 3" layer of specified mulch.

3.04 CONCRETE MOW STRIP

- A. Concrete mow strip shall comply with details on the plan.
- B. End of mow strip shall meet flush and at a 90 degree angle to abutting material.

- C. Height of mow strip shall not vary more than ½" over finish grade.

3.05 DECOMPOSED GRANITE

A. Path area

1. Spread and thoroughly blend decomposed granite, after achieving proper moisture content.
2. Lifts shall not exceed 4 inches in uncompacted thickness.
3. Prior to compaction, bring fill to proper moisture content (3 to 5% above optimum) by aeration or moistening.
4. Compact each lift to uniform compaction throughout each lift.
5. Finish grade all surfaces where indicated and within the construction areas to elevations indicated and as required to ensure proper drainage and disposal of surface water.
6. All finish grading shall be placed to a vertical tolerance of plus or minus 1/20 (.05) foot.

3.06 MAINTENANCE AND PROTECTION OF EXISTING TREES AND SHRUBS TO REMAIN

- A. General: Conform to all applicable specifications regarding pruning, watering, spraying and fertilizing of new vegetation as specified in this section. All existing trees and shrubs are to be continually watered and maintained throughout the construction period. *The condition of all plant materials to remain shall be assessed by Landscape Architect after construction.*
- B. The soil and grade under the dripline of the existing trees shall not be altered during development. Autos, trucks and machinery shall not be parked, driven or stored under the trees during the development phase. A temporary barrier shall be placed around the trees at the edge of the canopy until construction is completed.
- C. Trenching inside the dripline or within the root zone (five feet from the dripline) shall be avoided if possible. If trenching is necessary, all utilities should be placed within one trench.
1. Prior to trenching the root zone the affected trees shall be thoroughly irrigated the length of the trench.
 2. Trenching shall be by auguring or by hand trenching. Roots over one inch in diameter shall be preserved if at all possible. These roots shall not be ripped but cleanly cut along the sides of the trench.
 3. All excavated soil shall be replaced and tapped down in the trench so that so that no fill remains under the dripline of the tree and the grade is restored to its predisturbance condition.
 4. After the trench is filled, the area under the tree's dripline shall be irrigated so that water penetrates to the depth of the trench bottom.

- 5. Significant drainage changes around existing trees shall be corrected if grade changes occur during construction or if a retaining wall is constructed within the root zone of the tree.
- D. Be alert to symptoms of construction damage to root systems of existing trees as evidenced by wilting, unseasonal loss of leaves, and insect or disease infestation due to declining vigor.
- E. Notify the Owner's representative in writing of all evidence of declining tree vigor immediately upon discerning the problem. Take appropriate interim measures to mitigate the severity of the problem as specified in this section.
- F. Submit a written proposal and cost estimate for the correction of all conditions before proceeding with the permanent correction work.

3.07 WEED CONTROL

- A. Keep all planting areas, including areas to receive sodding or hydroseeding, free from weeds at all times. Contractor shall be responsible for weed control throughout the installation period and prior to the pre-maintenance acceptance.
- B. After planting is completed, a pre-emergence herbicide shall be applied to all shrub, 4"/5½" pot and groundcover areas. Water to a depth of ¼". Do not apply to seeded areas, or areas to receive sod.

3.08 TURF ERADICATION

- A. Where specified on plan (in the existing turf and planter areas), an "irrigation - germination - weed eradication" program shall be performed until all non-specified plant material has been removed. The "irrigation - germination - weed eradication" program shall be performed a minimum of two (2) times or until all turf grass has been killed and removed. Contractor shall use a "post-emergence weed killer": "Roundup" or approved equal.

3.09 CLEAN-UP

- A. Keep all areas of work clean, neat and orderly at all times. Keep all paved areas clean during planting and maintenance operations. Clean up and remove all deleterious materials and debris from the entire work area prior to final acceptance to the satisfaction of the Landscape Architect.
- B. Comply with all applicable storm water pollution prevention plans.

3.10 PRE-MAINTENANCE ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work. Upon pre-maintenance acceptance, the Landscape Architect will give written notification to commence 90 day maintenance period.

3.11 MAINTENANCE

- A. After all work indicated on the drawings and specifications has been completed, inspected and approved by the Landscape Architect, the maintenance period shall begin. The Contractor shall

maintain all planted areas by means of continuous watering, weeding, mowing, re-seeding, cultivation, spraying, mulching, pruning, edging and/or any other operation necessary for their care and upkeep for the period of ninety (90) calendar days.

- B. All areas shall be kept weed free during the maintenance period. Groundcover, 4"5½" pot and shrub areas shall be cultivated regularly to maintain a loose, attractive soil.
- C. The Contractor shall immediately replace any and all plant materials, which, for any reason, die or are damaged while under his care. Replacement plants shall be of the same quality as the original specified plants.
- D. Damage to planting areas shall be repaired immediately. Any settling of the soil shall be repaired, design grades re-established and areas replanted. Depressions caused by foot traffic will be filled with soil and leveled.
- E. Top-dress fertilizer shall be applied at 8 pounds per 1000 s.f. to all hydroseeded turf and flatted groundcover areas; 2 pounds per 100 s.f. to 4"5½" pot areas, at 30 and 45 days after the maintenance period is started (provide invoices and delivery tickets). NOTE: *Wash all fertilizer material from leaves.*
- F. To all shrub, 4"5½" pot and groundcover areas apply a pre-emergence spray or granular application at the start and end of the maintenance period.
- G. At completion of the maintenance period, all areas included in this contract shall be clean and free of debris and weeds, all plant materials shall be live, healthy and free of infestation.
- H. Turf areas shall be mowed at least once during maintenance period. No grass or weed growth shall be allowed to exceed 3" in height and shall be cut back each time to 1½" in height. Spot cutting shall also be done so that no part exceeds 3" in height at any time. All clippings and debris shall be removed (at contractor's expense) and disposed of off-site in a legal manner.
- I. To all turf areas apply a broad-leaf herbicide after three mowings. If weeds reappear, a second application shall be required prior to the end of the maintenance period.

3.12 FINAL ACCEPTANCE

- A. Work under this section will be accepted by the Landscape Architect upon satisfactory completion of all work (including maintenance). Upon final acceptance, and written notification, the Owner will assume responsibility for maintenance of the work.

END OF SECTION

SECTION 32 91 19 LANDSCAPE GRADING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Topsoil placement.
- B. Finish grading.

1.02 RELATED REQUIREMENTS

- A. Section 31 10 00 - Site Clearing.
- B. Section 31 22 00 - Grading.

1.03 PRICE AND PAYMENT PROCEDURES

1.04 REFERENCE STANDARDS

- A. 29 CFR 1910.266 - Logging Operations; Current Edition.
- B. ASTM D5268 - Standard Specification for Topsoil Used for Landscaping and Construction Purposes; 2023.

1.05 SUBMITTALS

- A. Project Record Documents: Accurately record actual locations of utilities remaining by horizontal dimensions, elevations or inverts, and slope gradients.
- B. Field Quality Control Submittals: Topsoil depth measurements.

1.06 QUALITY ASSURANCE

- A. Perform work in accordance with City of _____, Public Works Department standards.
 - 1. Maintain one copy on-site.

1.07 FIELD CONDITIONS

- A. Place topsoil during dry weather.
- B. Ambient Conditions: Terminate work during hazardous environmental conditions in accordance with 29 CFR 1910.266.
- C. Existing Conditions: See site drawing; see Section 00 31 00 - Available Project Information.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Topsoil: Comply with ASTM D5268.
- B. Topsoil: Topsoil excavated on-site.
 - 1. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
 - 2. Acidity Range (pH): 5.5 to 7.5.
 - 3. Mechanical Analysis:
 - a. Sand: 70 to 85 percent.

- b. Silt: 10 to 20 percent.
- c. Clay: 10 to 15 percent.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify grading and intended elevations are as indicated on drawings.
- B. Verify absence of standing or ponding water.

3.02 PREPARATION

- A. Protect site features to remain, including bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs.
- B. Protect trees, plants, lawns, and other features to remain.
- C. Remove debris, roots, branches, stones, in excess of 1/2 inch in size.
- D. Scarify surface to depth of 3 inches.
- E. Clear site; see Section 31 10 00.
- F. Grade substrate, see Section 31 22 00.

3.03 TOPSOIL PLACEMENT

- A. Uniformly distribute and spread topsoil.
- B. Place topsoil in areas where seeding, sodding, and planting as indicated on drawings.
- C. Place topsoil to the following compacted thicknesses:
 - 1. Areas Indicated Seeded with Grass: 6 inches.
 - 2. Areas Indicated as Sodded: 4 inches.
 - 3. Shrub Beds: 18 inches.
 - 4. Flower Beds: 12 inches.

3.04 FINISH GRADING

- A. Maintain profiles and contour of subgrade.
- B. Remove roots, weeds, rocks, and foreign material while spreading.
- C. Maintain uniform topsoil thickness.
- D. Lightly compact placed topsoil.
- E. Maintain stability of topsoil during inclement weather. Replace eroded topsoil.

3.05 TOLERANCES

- A. Topsoil Thickness: 1/2 inch plus/minus.

3.06 CLEANING

- A. See Section 01 70 00 - Execution and Closeout Requirements for additional requirements.
- B. Remove unused topsoil. Grade stockpile area to prevent standing water.

3.07 PROTECTION

- A. Protect from stormwater runoff and subsequent construction operations.

BATTLES ES - TK-K BUILDING AND SITE UPGRADES
SANTA MARIA-BONITA SCHOOL DISTRICT
SANTA MARIA, CALIFORNIA

DLR GROUP: 75-24119-00
SEPTEMBER 5, 2024
CONSTRUCTION DOCUMENTS

- B. Do not permit traffic until established.

END OF SECTION

SECTION 32 92 00 TURF SODDING

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work Included:

1. All labor, materials, tools and the transportation and the performance of all the work required as indicated on the drawings and specifications, and reasonably incidental to:
 - a. Furnish all plant material;
 - b. Preparation and placing of sodded areas;
 - c. Clean-up;
 - d. Guarantee.

B. Related work specified elsewhere includes but may not be limited to:

1. Section 32 80 00 – Landscape Irrigation;
2. Section 32 90 00 – Landscape Planting.

C. Requirements

1. Obstructions to landscaping operations: If rock, plaster, concrete debris, electrical cables, conduits or utility lines are encountered and cause conflict with landscaping operations, notify the Landscape Architect immediately to arrange relocation or to perform clean-up work.
2. Guarantees: The Contractor shall repair or replace any or all of the work, together with any other adjacent work which may be displaced by so doing, that may prove to be defective in its workmanship or material for the period of 90 days for all sodded areas from date of acceptable or substantial completion of the work by the Owner; ordinary wear and tear expected.

PART 2 – PRODUCTS

2.01 TURF DESCRIPTION

- ##### **A. Refer to planting plan/notes for type of sod.**
- Central Coast Sod Inc. (805) 934-2072, Triumph II*

PART 3 – EXECUTION

3.01 SOIL PREPARATION

- A. All areas shall be compacted with a water-filled roller to provide a smooth finish surface. Final compaction shall range between 85% for level areas, and up to 90% for 2:1 slopes.
- B. Soil shall be left 1½" (one and one-half inch) below finish grade as the sod will bring the level up to the proper height.
- C. After preparation of soil, the area must be pre-irrigated to wet it to a depth of four (4) inches. It shall be damp but not muddy and without depressions.

3.02 SOD PLACEMENT

- A. Initial placement of sod shall be laid within two (2) days after it is delivered. It shall not be left in the hot sun nor left in rolls or stacked overnight.
- B. Prior to placing of sod, broadcast 6-20-20 complete fertilizer at a rate of ten (10) pounds per 1,000 square feet over surface.
- C. Sod shall be unrolled and placed carefully in a staggered pattern. A piece of 2 x 4 shall be used to tamp each roll against the adjacent strips to eliminate joints and edges.
- D. Sod shall be trimmed to conform to lawn shapes designated in planting plan.
- E. After sod is laid, it shall be irrigated thoroughly to provide good moisture penetration.
- F. All sod areas shall be rolled with a Ryan Manufacturing Company sod roller not later than five (5) days after installation. Sod shall conform with finish grade, existing sidewalk and contours. A second rolling will be necessary if the first does not meet specifications.
- G. All perimeter and border areas shall not be laid with less than full width sod nor less than one-half length sod. (Sod width - 12"; sod length - 48").
- H. All sod in sodded areas shall be handled and laid in a high standard workmanship manner. All ends, joints, and cuts to be fit and tightly joined so there are no voids and the final appearance is one of continuous lawn.

END OF SECTION

SECTION 33 01 10.58
DISINFECTING OF SITE WATER DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Disinfection of site domestic water lines and site fire water lines specified in Section 33 14 16.
- B. Disinfection of building domestic water piping specified in Division 22.
- C. Testing and reporting results.

1.02 RELATED REQUIREMENTS

- A. Section 33 14 16 - Site Water Distribution Piping.

1.03 REFERENCE STANDARDS

- A. AWWA B300 - Hypochlorites; 2018.
- B. AWWA C651 - Disinfecting Water Mains; 2023.

1.04 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Test Reports: Indicate results comparative to specified requirements.
- C. Certificate: From authority having jurisdiction indicating approval of water system.
- D. Certificate: Certify that cleanliness of water distribution system meets or exceeds specified requirements.
- E. Disinfection report:
 - 1. Type and form of disinfectant used.
 - 2. Date and time of disinfectant injection start and time of completion.
 - 3. Test locations.
 - 4. Initial and 24 hour disinfectant residuals (quantity in treated water) in ppm for each outlet tested.
 - 5. Date and time of flushing start and completion.
 - 6. Disinfectant residual after flushing in ppm for each outlet tested.
- F. Bacteriological report:
 - 1. Date issued, project name, and testing laboratory name, address, and telephone number.
 - 2. Time and date of water sample collection.
 - 3. Name of person collecting samples.
 - 4. Test locations.
 - 5. Initial and 24 hour disinfectant residuals in ppm for each outlet tested.
 - 6. Coliform bacteria test results for each outlet tested.
 - 7. Certification that water complies, or fails to comply, with bacterial standards of County Health Department.

1.05 QUALITY ASSURANCE

- A. Water Treatment Firm: Company specializing in disinfecting potable water systems specified in this Section with minimum three years documented experience.
- B. Testing Firm: Company specializing in testing potable water systems, certified by governing authorities of California.
- C. Submit bacteriologist's signature and authority associated with testing.

PART 2 PRODUCTS

2.01 DISINFECTION CHEMICALS

- A. Chemicals: AWWA B300 Hypochlorite, AWWA B301 Liquid Chlorine, AWWA B302 Ammonium Sulfate, and AWWA B303 Sodium Chlorite.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that piping system and water well has been cleaned, inspected , and pressure tested.
- B. Schedule disinfecting activity to coordinate with start-up, testing, adjusting and balancing, demonstration procedures, including related systems.

3.02 DISINFECTION

- A. Use method prescribed by the applicable state or local codes, or health authority or water purveyor having jurisdiction, or in the absence of any of these follow AWWA C651.
- B. Provide and attach equipment required to perform the work.
- C. Inject treatment disinfectant into piping system.
- D. Maintain disinfectant in system for 24 hours.
- E. Flush, circulate, and clean until required cleanliness is achieved; use municipal domestic water.
- F. Replace permanent system devices removed for disinfection.
- G. Pressure test system to 120 psi. Repair leaks and re-test.

3.03 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Test samples in accordance with AWWA C651.

END OF SECTION

SECTION 33 05 43 CORROSION PROTECTION

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Protection of all underground utilities from corrosion.

1.02 RELATED REQUIREMENTS

- A. Section 01 30 00 - Administrative Requirements: Submittal procedures, reports, coordination.
- B. Section 33 14 16 - Site Water Distribution Piping.
- C. Section 33 31 13 - Site Sanitary Sewerage Piping.
- D. Section 33 41 00 - Subdrainage.
- E. Section 33 42 11 - Stormwater Gravity Piping.
- F. Section 33 52 16 - Gas Hydrocarbon Piping.

1.03 REFERENCE STANDARDS

- A. ASTM B280 - Standard Specification for Seamless Copper Tube for Air Conditioning and Refrigeration Field Service; 2023.
- B. ASTM B88 - Standard Specification for Seamless Copper Water Tube; 2022.
- C. AWWA C200 - Steel Water Pipe, 6 In. (150 mm) and Larger; 2017.
- D. AWWA C222 - Polyurethane Coatings for the Interior and Exterior of Steel Water Pipe and Fittings; 2008 (Including Addendum C222A-09).
- E. AWWA C214 - Tape Coating Systems for the Exterior of Steel Water Pipelines; 2007.
- F. AWWA C203 - Coal-Tar Protective Coatings and Linings for Steel Water Pipe; 2020.
- G. AWWA C213 - Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings; 2015.
- H. AWWA C205 - Cement-Mortar Protective Lining and Coating for Steel Water Pipe—4 In. (100 mm) and Larger—Shop Applied; 2018.
- I. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- J. AWWA C217 - Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings; 2016.
- K. ACI 318 - Building Code Requirements for Structural Concrete; 2019 (Reapproved 2022).
- L. NACE SP0169 - Control of External Corrosion on Underground or Submerged Metallic Piping Systems; 2013.
- M. NACE SP0286 - Electrical Isolation of Cathodically Protected Pipelines; 2007.
- N. SSPC-SP 6 - Commercial Blast Cleaning; 2007.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of corrosion protection with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's product literature, component dimensions, describe components within assembly, anchorage and fasteners, and special installation requirements.
- C. Test Reports: Indicate electrical continuity.
- D. Manufacturer's Field Reports: Indicate procedures followed and supplementary instructions given.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Installer Qualifications: Company specializing in performing work of the type specified and with minimum three years of documented experience.
- C. Testing Agency Qualifications: Independent firm specializing in performing testing and inspections of the type specified in this section.
- D. Copies of Documents at Project Site: Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to project site in unopened packaging until ready for installation.
- B. Store components under a dry covered area and elevated above grade.

1.08 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.

PART 2 PRODUCTS

2.01 APPLICATIONS / SYSTEM DESCRIPTION

- A. Steel Pipe or Valve Assemblies:
 - 1. Implement all the following measures:
 - a. Underground steel pipe with rubber gasketed, mechanical, grooved end, or other nonconductive type joints should be bonded for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
 - b. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:
 - 1) Dissimilar metals.
 - 2) Dissimilar coated piping (cement-mortar vs. dielectric).
 - 3) Above ground steel pipe.
 - 4) All existing piping.
 - c. Choose one of the following corrosion control options:
 - OPTION 1
 - 1) Apply a suitable dielectric coating intended for underground use such as:
 - (a) Polyurethane per AWWA C222; or

- (b) Extruded polyethylene per AWWA C215; or
- (c) A tape coating system per AWWA C214; or
- (d) Hot applied coal tar enamel per AWWA C203; or
- (e) Fusion bonded epoxy per AWWA C213.

- 2) Apply cathodic protection to steel piping as per NACE SP0169.

OPTION 2

- 3) As an alternative to dielectric coating and cathodic protection, apply a 3 inch cement mortar coating per AWWA C205 or encase in Type V - Sulfate Resistant concrete 3 inches thick, using any type of cement. Joint bonds, test stations, and insulated joints are still required for these alternatives.

- 2. NOTE: Some steel piping systems, such as for oil, gas, and high-pressure piping systems, have special corrosion and cathodic protection requirements that must be evaluated for each specific application.

B. Iron Pipe or Valve Assemblies:

- 1. Implement all the following measures:

- a. Choose one of the following corrosion control options:

OPTION 1

- 1) Apply a suitable coating intended for underground use such as:
 - (a) Polyethylene encasement per AWWA C105/A21.5; or
 - (b) Epoxy coating; or
 - (c) Polyurethane; or
 - (d) Wax tape.
- 2) NOTE: The thin factory-applied asphaltic coating applied to ductile iron pipe for transportation and aesthetic purposes does not constitute a corrosion control coating.
- 3) Apply cathodic protection to cast and ductile iron piping as per NACE SP0169.

OPTION 2

- 4) As an alternative to coating systems described in Option 1 and cathodic protection, Type V - Sulfate Resistant concrete encase all buried portions of metallic piping so that there is a minimum of 3 inches of concrete cover provided over and around surfaces of pipe, fittings, and valves using any type of cement.

C. Copper Tubing:

- 1. Protect buried copper tubing by one of the following measures:
 - a. Installation of a factory-coated copper pipe with a minimum 25-mil thickness. The coating must be continuous with no cuts or defects.
 - b. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

2.02 MATERIALS

A. Factory Coated Potable Water Copper Piping:

- 1. Coating: Polyethylene.
- 2. Thickness: 25 mils on 5/8 inch pipe.

3. Copper Pipe: Type as indicated in Division 22 and 33.
4. Manufacturers:
 - a. Kamco Products Limited; Aqua Shield™;: www.kamcoproducts.com.
 - b. Mueller Industries; Streamline Protec™: www.muellerindustries.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Factory Coated Natural Gas and LP Gas Copper Piping:
 1. Coating: Linear Low Density Polyethylene LLDPE Extrusion Resin.
 - a. Additional Outer Sleeve Option: Black HDPE Outer Sleeve.
 2. Thickness: 25 mils on 5/8 inch pipe.
 3. Copper Pipe: Type as indicated in Division 22, 23, and 33.
 - a. Type L, ASTM B88.
 - b. REF Type, ASTM B280.
 4. Manufacturers:
 - a. Kamco Products Limited; Gas-Tec™: www.kamcoproducts.com.
 - b. Mueller Industries; Streamline Protec™: www.muellerindustries.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Tape Coating System:
 1. Basis of Design: Polyken manufacture by Berry Plastics Corporation, www.berryplastics.com or approved equal..
 2. Provide straight pipe sections with a four layer polyethylene tape system, where not factory coated:
 - a. Products:
 - 1) Primer: 1027 Butyl Liquid Adhesive and Primer
 - 2) Filler tape: 939
 - 3) Weld stripping tape: 933-25 black
 - 4) Inner layer tape: 989-20 black
 - 5) Middle layer tape: 955-30 gray
 - 6) Outer layer tape: 956-30 white
 - b. Primer layer.
 - c. Filler tape, extruded butyl rubber compound compatible with the primer and tape.
 - d. Weld stripping tape, if required (25 mils).
 - e. Inner layer, corrosion protection tape (20 mils).
 - f. Middle layer, mechanical protection tape (30 mils).
 - g. Outer layer, mechanical protection tape (30 mils) with ultraviolet light stabilizers.
 - h. Total system thickness shall be at least 80 mils.
 - i. Provide coating materials supplied by a single manufacturer, and shall have a successful application and service history on pipe fabricated in accordance with AWWA C200.
 3. Provide fittings, specials, and field joints with a three layer polyethylene tape system:
 - a. Products:

- 1) Primer: 1027 Butyl Liquid Adhesive and Primer
- 2) Filler tape: 939
- 3) Inner layer tape: 930-50 black
- 4) Outer layer tape: 955-30 white
- b. Primer layer
- c. Filler tape, extruded butyl rubber compound compatible with the primer and tape.
- d. Inner layer, corrosion protection tape (50 mils).
- e. Outer layer, mechanical and ultraviolet light protection tape (30 mils).
- f. Total system thickness shall be at least 80 mils.
- g. The coating materials shall be supplied by the same manufacturer as the materials for straight pipe.
4. Storage of Materials: Store materials within the temperature ranges specified for application, using heated storage areas if necessary. Tape shall be stored at a minimum temperature of 70 degrees F
- D. Mortar Coating:
 1. Thickness: 1 inch thick reinforced mortar coating over the tape coat system.
 2. Mortar Coating: Comply with AWWA C205.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Verify that piping is installed correctly and tested.

3.02 CORROSION PROTECTIVE COATING APPLICATION

- A. Comply with NACE SP0169.
- B. Steel Pipe or Valve Assemblies:
 1. Implement all the following measures:
 - a. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
 - 1) At each end of the pipeline.
 - 2) At each end of all casings.
 - 3) Other locations as necessary so the interval between test stations does not exceed 1,200 feet.
 - b. To prevent dissimilar metal corrosion cells and to facilitate the application of cathodic protection, electrically isolate each buried steel pipeline per NACE SP0286 from:
 - 1) Dissimilar metals.
 - 2) Dissimilar coated piping (cement-mortar vs. dielectric).
 - 3) Above ground steel pipe.
 - 4) All existing piping.
- C. Iron Pipe or Valve Assemblies:
 1. Implement all the following measures:

- a. Electrically insulate underground iron pipe from dissimilar metals and from above ground iron pipe with insulating joints per NACE SP0286. (e.g.; Flange Isolation Joint Kits. This is especially important for fire risers.)
- b. Bond all nonconductive type joints for electrical continuity. Electrical continuity is necessary for corrosion monitoring and cathodic protection.
- c. Install corrosion monitoring test stations to facilitate corrosion monitoring and the application of cathodic protection:
 - 1) At each end of the pipeline.
 - 2) At each end of any casings.
 - 3) Other locations as necessary so the interval between test stations does not exceed 1,200 feet.

D. Copper Tubing:

1. Protect buried copper tubing by one of the following measures:
 - a. Prevention of soil contact. Soil contact may be prevented by placing the tubing above ground or encasing the tubing using PVC pipe with solvent-welded joints.
 - b. Installation of a factory-coated copper pipe with a minimum 25-mil thickness. The coating must be continuous with no cuts or defects.
 - c. Installation of 12-mil polyethylene pipe wrapping tape with butyl rubber mastic over a suitable primer. Protect wrapped copper tubing by applying cathodic protection per NACE SP0169.

E. Plastic and Vitrified Clay Pipe

1. No special precautions are required for plastic and vitrified clay piping placed underground from a corrosion viewpoint.
2. Protect all metallic fittings and valves with wax tape per AWWA C217 or epoxy.

F. All Pipe or Valve Assemblies:

1. On all pipes, appurtenances, and fittings not protected by cathodic protection, coat bare metal such as valves, bolts, flange joints, joint harnesses, and flexible couplings with wax tape per AWWA C217 after assembly.
2. Where metallic pipelines penetrate concrete structures such as building floors, vault walls, and thrust blocks use plastic sleeves, rubber seals, or other dielectric material to prevent pipe contact with the concrete and reinforcing steel.

G. Concrete

1. From a corrosion standpoint, any type of cement may be used for concrete structures and pipe because the sulfate concentration is negligible, 0 to 0.1 percent. ACI 318, Table 19.3.2.1.
2. Standard concrete cover over reinforcing steel may be used for concrete structures and pipe in contact with these soils due to the low chloride concentration found on-site. (Design Manual 303: Concrete Cylinder Pipe. Ameron. p.65)

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Tape Application:

1. Tape coating materials shall be applied in accordance with this Section, the product application instructions of the tape manufacturer, and the field technical support instructions from the manufacturer.

2. Weld Surface Preparation:

- a. To provide for an effective, long-term bond between the tape coating system and the substrate, the following pipe weld surface preparation shall be provided.
 - 1) Weld surfaces with a reinforcement greater than 1/32-inch and all longitudinal and coil splice welds shall be ground to provide a smooth surface with a reinforcement not exceeding 1/32-inch. The resulting weld surface shall have a cross-section shape that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate.
- b. Weld Stripping Tape: Provide weld stripping tape, 6 inches wide, if any of the following conditions are present. Apply tape with the center of the tape at the weld.
 - 1) If elected to use stripping tape in lieu of grinding or part of the grinding required above. In such a case, the weld reinforcement is not to exceed 3/32-inch, and the weld surface shall have a cross-section shape that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate.
 - 2) If the initial pipe sections taped have indications that the inner tape layer is not bonding completely to the pipe at the welds.
 - 3) If the tape bond to the welds or adjacent surfaces is less than the tape bond to the pipe surface away from the welds.
- c. Welds that have been prepared with a reinforcement not exceeding 1/32-inch, and a cross section slope that is free of discontinuities, abrupt changes in curvature, with no ridges or valleys that may promote bridging or disbondment of the tape from the substrate require no additional preparation.

3. Pipe Surface Preparation:

- a. Detergent clean surfaces to be coated in accordance with SSPC-SP1 prior to abrasive blasting.
- b. Remove all burrs, sharp edges, and weld splatter prior to abrasive blasting.
- c. Abrasive blast immediately before application of the primer.
 - 1) Use sand, metallurgical slag, or a combination of steel grit and shot to produce a surface in conformance with SSPC-SP 6.
 - 2) Steel grit shall comprise at least 60 percent of the working mix of abrasive, if a centrifugal wheel abrasive blaster is used.
 - 3) The prepared surface shall have a surface profile not exceeding 2 mils.
- d. Apply abrasive blasting and primer application when the substrate surface is at least 5 degrees F above the dew point.
 - 1) Provide abrasive blasting, priming, and inner layer tape application during the same working day for each pipe section.

4. Pipe End Preparation:

- a. Coating cut-backs at the pipe ends: 6 inches, with the cuts parallel to the pipe ends.
 - 1) Protect exposed substrate surfaces with a storage primer applied immediately after taping and before flash rusting of the surface.
- b. Spiral or longitudinal pipe welds within two feet of the pipe ends shall be ground flush prior to abrasive blast cleaning.

- c. Pipe ends that will be connected with sleeve-type couplings shall be epoxy coated for immersion service.
 - 1) Cut-Backs: Minimum 6 inches at couplings to provide clearance between the coupling and tape.
 - 2) Epoxy Coating: Extend minimum 6 inches beyond each side of the sleeve coupling on the outside surface of the pipe.
- 5. Application of Tape:
 - a. Maintain pipe shell temperature within a range of 45 degrees F to 100 degrees F during application of the tape system.
 - b. Maintain inner layer tapes a minimum temperature of 70 degrees F during application.
 - 1) Maintain middle and outer layer tapes at a minimum temperature of 90 degrees F during application.
 - c. Tape Application Tension: Maintained at a value that produces a tape width reduction equal to 1.0 to 2.0 percent of the tape width during application, as recommended by the tape manufacturer. Maintain width reduction simultaneously with the minimum tape temperature.
 - d. At the point of tape application, all tape, including weld stripping tape, press onto the pipe with a pressure roller that maintains a constant pressure. Use enough pressure to fully bond the tape at all welds.
 - e. Filler tape shall be used at lap joints, weld step-downs, and other discontinuities.
 - f. The tape application equipment and materials shall result in a fully bonded tape coating system, without blisters, voids, wrinkles or any areas that have a lack of bond to the pipe.
 - g. Succeeding layers of tape shall be applied so that the laps are staggered by at least two inches.
 - h. Before tape application, the primer shall be dried sufficiently so that the primer is in a tacky to dry condition.
 - i. Primer: Apply while it is in a temperature range of 50 degrees F to 80 degrees F, using airless spray equipment and a drum agitator. Application shall be of uniform thickness on all pipe surfaces.
- 6. Repair Patches
 - a. Repair patches shall be applied by wrapping tape completely around the pipe, using the tape system for joints.
- 7. Tape Application to Fittings, Specials:
 - a. Filler tape shall be used to fill voids on fittings, specials, welds, and pipe joints.
 - b. All bell and spigot joints, lap joints, and other locations where voids will otherwise exist: Provide specially shaped, filler tape applied after priming.
 - c. Field pipe joints shall be prepared as required by the paragraph entitled "Pipe Surface Preparation," except that shop blasted surfaces that have been coated with a storage primer or an epoxy coating may be power tool cleaned instead of abrasive blast cleaned. The power tool cleaning shall be done in accordance with SSPC-SP2. Pipe ends not effectively protected with a storage primer shall be abrasive blasted to SSPC-SP6.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Test for electrical continuity in accordance with NACE SP0286.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 01 78 00 - Closeout Submittals, for closeout submittals.

3.06 PROTECTION

- A. Protect installed coatings from subsequent construction operations.

END OF SECTION

SECTION 33 14 16 SITE WATER DISTRIBUTION PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water pipe for site conveyance lines.
- B. Pipe valves.
- C. Fire hydrants.
- D. Backflow preventers - reduced pressure principle assemblies.
- E. Site water lines up to approximately 5 feet from the building perimeter. See individual building systems for continuation.

1.02 RELATED REQUIREMENTS

- A. Section 21 11 00 - Facility Fire-Suppression Water-Service Piping.
- B. Division 22 - Plumbing: Underground water line extension into the building.
- C. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- D. Section 33 01 10.58 - Disinfecting of Site Water Distribution Piping: Disinfection of site service utility water piping.
- E. Section 33 05 43 - Corrosion Protection: Reducing exposure of metal parts in sulfate containing soils.

1.03 REFERENCE STANDARDS

- A. ASSE 1013 - Performance Requirements for Reduced Pressure Principle Backflow Prevention Assemblies; 2021.
- B. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications; 2023a.
- C. ASTM A506 - Standard Specification for Alloy and Structural Alloy Steel, Sheet and Strip, Hot-Rolled and Cold-Rolled; 2016.
- D. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength; 2021.
- E. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- F. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120; 2021a.
- G. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40; 2023.
- H. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets; 2020.
- I. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes using Flexible Elastomeric Seals; 2019.
- J. {RSTEMP#1217}
- K. ASTM F594 - Standard Specification for Stainless Steel Nuts; 2022.

- L. AWWA C105/A21.5 - Polyethylene Encasement for Ductile-Iron Pipe Systems; 2018.
- M. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings; 2023.
- N. AWWA C500 - Metal-Seated Gate Valves for Water Supply Service; 2019.
- O. AWWA C504 - Rubber-Seated Butterfly Valves; 2023.
- P. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 48-In. (50-mm Through 1,200-mm) NPS; 2017.
- Q. AWWA C600 - Installation of Ductile-Iron Mains and Their Appurtenances; 2023.
- R. AWWA C606 - Grooved and Shouldered Joints; 2022.
- S. AWWA C900 - Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 In. through 60 In. (100 mm through 1500 mm); 2022.
- T. NSF 61 - Drinking Water System Components - Health Effects; 2023, with Errata.
- U. NFPA 24 - Standard for the Installation of Private Fire Service Mains and Their Appurtenances; 2022.
- V. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.
- W. UL 246 - Hydrants for Fire-Protection Service; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- B. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe materials, pipe fittings, joints, couplings, valves and accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
 - 1. Submit a certificate stating that the meters have been tested and that the accuracy and capacity meet the requirements of AWWA C700 when tested in accordance with AWWA Standards according to type installed.
- D. Shop Drawings: Submit shop drawings for potable water system, showing piping materials, size, locations, and elevations. Include details of underground structures, connections, thrust blocks, and anchors. Show interface and spatial relationship between piping and proximate structures.
- E. Certificates: Provide a NFPA 24 Certificate of installation with copies for District, Architect, local fire officials, and DSA.
- F. Project Record Documents:
 - 1. Record actual locations of piping mains, valves, connections, thrust restraints, and invert elevations.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.
 - 3. On a set of Contractor Drawings, kept at the site during construction, mark construction that is installed differently from that indicated.

- a. Locate materials installed underground by dimensions from fixed identifiable points whether installed as indicated or not.
- G. Maintenance Data:
 1. Submit maintenance data and parts list for potable water system materials and products.
 2. Include this data, product data, shop drawings, and record drawings in maintenance manual; in accordance with requirements of Section 01 78 00 - Closeout Submittals.

1.06 QUALITY ASSURANCE

- A. Perform Work in accordance with utility company requirements.
- B. Manufacturer's Qualification: Firms regularly engaged in manufacture of potable water system materials and products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
- C. Installer's Qualifications: Firm with at least 3 years of successful installation experience on projects with potable water piping work similar to that required for project.

1.07 REGULATORY REQUIREMENTS

- A. Materials and installation: Comply with the following documents hereinafter referred to as the "SSPWC (Greenbook)".
- B. Install in accordance with County of Los Angeles Fire Department Regulation 8.
- C. Comply with NFPA 24 as adopted by authority having jurisdiction.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Deliver and store valves in shipping containers with labeling in place.
- B. Do not store materials directly on the ground. Support the pipe uniformly during shipping and storage.
 1. Do not stack higher than 4 feet nor stack with weight on bells.
 2. Cover plastic pipe to protect it from sunlight.
 3. Keep inside of pipe and fittings free of dirt and debris.
 4. Avoid scratching the pipe surface.
- C. Do not install pipe that is cracked, broken, gouged, scratched or forming a clear depression. Remove damaged pipe from the site.
- D. Do not install pipe contaminated with a petroleum product or any other toxic material whether inside or outside of pipe.
- E. Take special care to avoid injury to coatings and linings on pipe and fittings; make satisfactory repairs if coatings or linings are damaged.
 1. Hoist pipe with mechanical equipment using a cloth belt sling or a continuous fiber rope which avoids scratching the pipe.
 2. Pipes may be lowered by rolling on two ropes controlled by snubbing.

1.09 WARRANTY

- A. See Section 01 78 00 - Closeout Submittals, for additional warranty requirements.
- B. Correct defective Work within a five year period after Date of Substantial Completion.

PART 2 PRODUCTS

2.01 SITE FIRE LINE SYSTEM DESCRIPTION

- A. CFC 507 and 901 with NFPA Compliance: NFPA 24.
 - 1. Coordinate installation with sprinkler risers at building to match requirements with NFPA 13.
- B. Local Fire Department/Fire Marshal Regulations: Comply with governing regulations pertaining to hydrants, including hose unit threading and similar matching of connections.
- C. UL Compliance: Provide fire hydrants that comply with UL 246, and are listed by UL, and approved by the authorities having jurisdiction.

2.02 WATER PIPE

- A. General:
 - 1. Provide piping materials and factory-fabricated piping products of size, type, pressure ratings, and capacities as indicated.
 - 2. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements.
 - 3. Provide size and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems.
 - 4. Where more than one type of materials or products are indicated, selection is Installer's option.
- B. Piping:
 - 1. Provide pipes of one of the following materials, of weight/class indicated.
 - 2. Provide pipe fittings and accessories of same material and weight/class as pipes, with joining method as indicated.
- C. Ductile Iron Pipe: AWWA C151/A21.51:
 - 1. Fittings: Ductile iron, standard thickness.
 - 2. Joints: AWWA C111/A21.11, rubber gasket with rods.
 - 3. Jackets: AWWA C105/A21.5 polyethylene jacket.
- D. PVC Pipe: ASTM D 1785, Schedule 80 for sizes 1/2 inch through 3 inches.
 - 1. Fittings: ASTM D2466, PVC, socket type, solvent cement joints; or elastomeric gaskets joints.
 - 2. Joints: ASTM D2855, solvent weld.
- E. PVC Pipe: AWWA C900 FM approved, Class 305 (formerly 200): for sizes 4 inches through 12 inches; UL Listed.
 - 1. Dimension Ratio: DR 25.
 - 2. Fittings: AWWA C111/A21.11, ductile-iron, cement lined, with rubber gaskets.
 - 3. Joints: ASTM D3139 compression gasket ring, bell and spigot.
- F. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Water Service" in large letters.

2.03 VALVES

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

- B. Gate Valves Up To 3 Inches:
 - 1. Brass or Bronze body, non-rising stem, inside screw, single wedge or disc, compression ends, with control rod, post indicator, valve key, and extension box.
- C. Gate Valves 3 Inches and Over:
 - 1. Manufacturers:
 - a. Mueller Co.
 - b. Decatur
 - c. Illinois
 - d. Kennedy Valve Div.
 - e. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. AWWA C500, iron body, bronze trim, non-rising stem with square nut, single wedge, flanged ends, control rod, post indicator, valve key, and extension box.
- D. Ball Valves Up To 2 Inches:
 - 1. Brass body, Teflon coated brass ball, rubber seats and stem seals, Tee stem pre-drilled for control rod, AWWA inlet end, compression outlet with electrical ground connector, with control rod, valve key, and extension box.
- E. Swing Check Valves From 2 Inches to 24 Inches:
 - 1. Manufacturers:
 - a. Clow Corp.
 - b. Fairbanks Co.
 - c. Kennedy Valve Div.
 - d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. AWWA C508, iron body, bronze trim, 45 degree swing disc, renewable disc and seat, flanged ends.
- F. Butterfly Valves From 2 Inches to 24 Inches:
 - 1. AWWA C504, iron body, bronze disc, resilient replaceable seat, water or lug ends, ten position lever handle.
- G. Valve Ends: Provide flanged, threaded, hub or sleeve type mechanical joint ends designed to suit pipe or tapping sleeves connections.

2.04 HYDRANTS

- A. Hydrants: Type as required by local Fire Department or utility company.
 - 1. Fire Service Hydrant:
 - a. Outlets:
 - 1) 4 inch diameter: One.
 - 2) 2-1/2 inch diameter: One.
- B. Hydrant Extensions: Fabricate in multiples of 6 inches with rod and coupling to increase barrel length.
- C. Hose and Streamer Connection: Match sizes with utility company, two hose nozzles , one pumper nozzle.
- D. Fire Department Connections: As required by Fire Department having jurisdiction and responsibility for serving site.

- E. Finish: Primer and two coats of enamel in color required by local Fire Department or utility company.

2.05 BACKFLOW PREVENTERS - REDUCED PRESSURE PRINCIPLE ASSEMBLIES

- A. Reduced Pressure Backflow Preventer Assemblies up to 2 Inches NPS:
 - 1. ASSE 1013; NSF 61; bronze body; two independently operating, spring-loaded check valves with stainless steel springs; differential pressure relief valve located between check valves; integral test fittings.
 - 2. Size: 3/4- to 2-inch NPS assembly with full port ball valves.
 - 3. Maximum Working Parameters: 175 psi at 180 degrees F.
 - 4. Accessories: Provide outdoor-mounted protective enclosure.

2.06 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 23.
- B. Cover: As specified in Section 31 23 23.

2.07 ACCESSORIES

- A. Bolts and Nuts for Flanges: Provide type 316 stainless steel (UNS s31600 / AISI 316 / ASTM A240/A240M) for all bolts, nuts washers and rods used for the installation of underground piping, valves and fittings.
 - 1. Bolts: Conform to {RS#1217}, Alloy Group 2, Condition CW1 (1/4 to 5/8 inch) and CW2 (3/4 to 1-1/2 inch).
 - 2. Nuts: Conform to ASTM F594, Alloy Group 2, Condition CW1 (1/4 to 5/8 inch) and CW2 (3/4 to 1-1/2 inch).
- B. Restraint Devices: Provide wedging action type mechanical restraint devices at all pipe joints.
 - 1. Rods, Nuts and Washers: Stainless Steel per {RS#1217} and ASTM F594.
 - 2. Products:
 - a. EBAA Iron Sales, Inc.: ebaa.com.
 - b. Uni-flange type.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Anchorages: Provide anchorages for tees, wyes, crosses, plugs, caps, bends, valves, and hydrants. After installation, apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of ferrous anchorages.
 - 1. Clamps, Straps, and Washers: Stainless Steel, ASTM F594.
 - 2. Rods: Stainless Steel, {RS#1217}.
 - 3. Bolts: Stainless Steel, {RS#1217}.
- D. Concrete: Ready-mixed, complying with ASTM C94/C94M; Type V - Sulfate Resistant Portland cement; 3,000 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.
- E. Meter:
 - 1. Comply with AWWA C700. Acceptable manufacturers, or equal.
 - 2. Acceptable manufacturers:
 - a. Western Water Meter Inc.
 - b. Rockwell International Corp.
 - c. Hersey Products Inc.

- d. Substitutions: See Section 01 60 00 - Product Requirements.
 - 3. Water meter shall be:
 - a. Flanged multijet turbine type.
 - b. Meet requirements of local water department.
 - 4. The meter housing shall be bronze with brass case and lid.
 - 5. Meter chamber shall be molded and corrosion resistant and shall have a sapphire rotor bearing. The meter register shall be vacuum sealed in copper housing with magnetic coupling. It shall have a leak indicator and heat tempered glass.
 - 6. Concrete Meter Box: Meter boxes shall be Brooks Concrete Works Series 3 through 37 meter box, standard meter vault or 300 Series meter vault, or equal, as required by local water department.
- F. Identification
- 1. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide blue tape with black printing reading "CAUTION WATER LINE BURIED BELOW".
 - a. Manufacturer: Subject to compliance with requirements, provide identification markers of one of the following:
 - 1) Allen Systems Inc.
 - 2) Seton Name Plate Corp.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.
 - 2. Nonmetallic Piping Label: If nonmetallic piping is used for water service, provide engraved plastic laminate, label permanently affixed to main electrical meter panel stating "THIS STRUCTURE HAS A NONMETALLIC WATER SERVICE".

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that building service connection and municipal utility water main size, location, and invert are as indicated.
- B. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 PREPARATION

- A. Cut pipe ends square, ream pipe and tube ends to full pipe diameter, remove burrs.
- B. Remove scale and dirt on inside and outside before assembly.
- C. Prepare pipe connections to equipment with flanges or unions.

3.03 TRENCHING

- A. See the sections on excavation and fill for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Form and place concrete for pipe (larger than 4 inches) thrust restraints at each change of pipe direction. Place concrete to permit full access to pipe and pipe accessories. Provide 4 sq ft thrust restraint bearing on subsoil.

- D. Do not backfill until installation has been approved and as-built drawings are up to date. Promptly install all piping after excavation or cutting for same has been done, so as to keep the excavations open as short a time as possible.
- E. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.04 INSTALLATION - PIPE

- A. General: During back-filling/topsoiling of underground potable water piping, install continuous underground-type plastic line markers located directly over buried lines at 6 to 8 inches below finished grade.
- B. Maintain separation of water main from sewer piping in accordance with plumbing code.
- C. Group piping with other site piping work whenever practical.
- D. Establish elevations of buried piping to ensure not less than 2 ft of cover.
- E. Install pipe to indicated elevation to within tolerance of 5/8 inches.
- F. Comply with Section 33 05 43 - Corrosion Protection.
- G. Install ductile iron piping and fittings to AWWA C600.
- H. Install grooved and shouldered pipe joints to AWWA C606.
- I. Polyvinyl Chloride Pipe: Install in accordance with manufacturer's installation instructions.
 - 1. Pressure water lines (4 inch and larger): Install in accordance with pipe manufacturers recommendations, or as shown in J-M Installation Guide "Ring-Tite PVC Pipe". Provide thrust blocks as required by "J-M Installation Guide".
- J. Route pipe in straight line.
- K. Install pipe to allow for expansion and contraction without stressing pipe or joints.
- L. Install access fittings to permit disinfection of water system performed under Section 33 01 10.58.
- M. Slope water pipe and position drains at low points.
- N. Install trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.
- O. Provide and install 14 gauge copper "Tracer" wire, continuous for entire length, for all underground non-metallic piping. Secure to piping at alternate joints, at each fitting and at each valve. Locate "Tracer" wire along side pipe, but not under pipe.
- P. Installation of identification: During backfilling/top-soiling of underground water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6 to 8 inches below finished grade.

3.05 INSTALLATION - VALVES, HYDRANTS, BACKFLOW PREVENTERS

- A. Check operation of all valves before installing. Install valves true to line and grade. Install valves in accordance with AWWA C600 and manufacturer's written instructions. Wrap all buried, ferrous metal valves with polyethylene film in conformance with Section 5-4 of AWWA C105/A21.5.
- B. Set valves on solid bearing.
- C. Install valves as indicated with stems pointing up. Provide valve box over underground valves.
- D. Center and plumb valve box over valve. Set box cover flush with finished grade.
- E. Set hydrants plumb; locate pumper nozzle perpendicular to and facing roadway in accordance with Section 21 11 00.

- F. Set hydrants to grade, with nozzles at least 20 inches above ground in accordance with Section 21 11 00.
- G. Locate control valve 4 inches away from hydrant.
- H. Provide a drainage pit 36 inches square by 24 inches deep filled with 2 inches washed gravel. Encase elbow of hydrant in gravel to 6 inches above drain opening. Do not connect drain opening to sewer.
- I. Install backflow preventers in accordance with requirements of local water utility and local authority having jurisdiction.
- J. Fire Department Connections: Install in accordance with AWWA C600 and manufacturers written instructions.

3.06 INSTALLATION OF WATER METERS

- A. Install water meter in accordance with AWWA C600 and/or utility company's installation instructions and requirements. Check operation of all meters before operation. Install in meter boxes where indicated.
- B. Size meter and arrange piping and specialties to comply with utility company's requirements.
- C. Set meter on concrete pad as indicated. Refer to Division 32 for concrete, formwork, and reinforcing material requirements.
- D. Mount meter on wall brackets as indicated.

3.07 ROUGH-IN FOR WATER METER

- A. Install rough-in piping and specialties for water meter installation in accordance with utility company's instructions and requirements.

3.08 ANCHORAGE INSTALLATION

- A. Provide anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches.

3.09 CORROSION **PROTECTIVE COATING APPLICATION**

- A. See Section 330543 - Corrosion Protection.
- B. Comply with NACE SP0169.

3.10 IDENTIFICATION INSTALLATION

- A. During backfilling/top-soiling of underground water piping systems, install continuous underground-type plastic line marker, located directly over buried line at 6 to 9 inches below finished grade.
- B. Attach nonmetallic piping label permanently to main electrical meter panel.

3.11 SERVICE CONNECTIONS

- A. Provide water service to utility company requirements with reduced pressure backflow preventer and water meter with bypass valves and sand strainer.
- B. Tap water main with size and in location as indicated, in accordance with requirements of City standards.
- C. Connections to Plumbing Systems: Make connections of service laterals to plumbing facilities at a location 5 feet outside the building line as indicated. Connections shall be made utilizing standard prefabricated adapters installed in accordance with the pipe manufacturer's recommendations.
- D. Anchor service main to interior surface of foundation wall.

3.12 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements, for additional requirements.
- B. Perform field inspection and testing in accordance with Section 01 40 00.
- C. Test valves for leakage and alignment prior to backfilling.
- D. Conduct piping tests before joints are covered, and after thrust blocks have sufficiently hardened. Fill pipeline 24 hours prior to testing, and apply test pressure to stabilize system. Use only potable water.
- E. Pressure test water piping to 200 pounds per square inch.
 - 1. PVC Water Pipelines: Test all water lines in accordance with manufacturers recommendations.
 - 2. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure for one hour, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.
 - 3. Test fails if leakage exceeds 2-qts per hour per 100 gaskets or joints, irrespective of pipe diameter.
- F. Pressure test fire line water piping to 200 psi, or 50 psi in excess system working pressure, NFPA 24.
 - 1. Increase pressure in 50 psi increments and inspect each joint between increments. Hold at test pressure within +/- 5 psi for two hours, decrease to 0 psi. Slowly increase again to test pressure and hold for one more hour.
- G. Fire Department Connections: On-site fire department connections shall be tested by the Contractor as directed by the Fire Department having jurisdiction. Perform all tests in the presence assigned Inspector.
- H. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to District.
- I. Submit the completed and approved NFPA 24 Certificate as indicated under Submittals in this section.

3.13 CLEANING

- A. Clean and disinfect water-distribution piping as indicated in Section 33 01 10.58 - Disinfecting of Site Water Distribution Piping.

END OF SECTION

Contractor's Material and Test Certificate for Underground Piping			
PROCEDURE Upon completion of work, inspection and tests shall be made by the contractor's representative and witnessed by an owner's representative. All defects shall be corrected and system left in service before contractor's personnel finally leave the job. A certificate shall be filled out and signed by both representatives. Copies shall be prepared for approving authorities, owners, and contractor. It is understood the owner's representative's signature in no way prejudices any claim against contractor for faulty material, poor workmanship, or failure to comply with approving authority's requirements or local ordinances.			
Property name			Date
Property address			
Plans	Accepted by approving authorities (names)		
	Address		
	Installation conforms to accepted plans <input type="checkbox"/> Yes <input type="checkbox"/> No Equipment used is approved <input type="checkbox"/> Yes <input type="checkbox"/> No If no, state deviations:		
Instructions	Has person in charge of fire equipment been instructed as to location of control valves and care and maintenance of this new equipment? If no, explain <input type="checkbox"/> Yes <input type="checkbox"/> No		
	Have copies of appropriate instructions and care and maintenance charts been left on premises? If no, explain <input type="checkbox"/> Yes <input type="checkbox"/> No		
Location	Supplies buildings		
Underground pipes and joints	Pipe types and class		Type joint
	Pipe conforms to _____ standard <input type="checkbox"/> Yes <input type="checkbox"/> No Fittings conform to _____ standard <input type="checkbox"/> Yes <input type="checkbox"/> No If no, explain:		
	Joints needing anchorage clamped, strapped, or blocked in accordance with _____ standard <input type="checkbox"/> Yes <input type="checkbox"/> No If no, explain:		
	Test description Flushing: Flow the required rate until water is clear as indicated by no collection of foreign material in burlap bags at outlets such as hydrants and blow-offs. Flush at one of the flow rates as specified in 10.10.2.1.3. Hydrostatic: All piping and attached appurtenances subjected to system working pressure shall be hydrostatically tested at 200 psi (13.8 bar) or 50 psi (3.5 bar) in excess of the system working pressure, whichever is greater, and shall maintain that pressure ± 5 psi (0.35 bar) for 2 hours. Hydrostatic Testing Allowance: Where additional water is added to the system to maintain the test pressures required by 10.10.2.2.1, the amount of water shall be measured and shall not exceed the limits of the following equation (for metric equation, see 10.10.2.2.6). $L = \frac{SD\sqrt{P}}{148,000}$ L = testing allowance (makeup water), in gallons per hour S = length of pipe tested, in feet D = nominal diameter of the pipe, in inches P = average test pressure during the hydrostatic test, in pounds per square inch (gauge)		
Flushing tests	New underground piping flushed according to _____ standard by (company) <input type="checkbox"/> Yes <input type="checkbox"/> No If no, explain:		
	How flushing flow was obtained <input type="checkbox"/> Public water <input type="checkbox"/> Tank or reservoir <input type="checkbox"/> Fire pump		Through what type opening <input type="checkbox"/> Hydrant butt <input type="checkbox"/> Open pipe
	Lead-ins flushed according to _____ standard by (company) <input type="checkbox"/> Yes <input type="checkbox"/> No If no, explain:		
	How flushing flow was obtained <input type="checkbox"/> Public water <input type="checkbox"/> Tank or reservoir <input type="checkbox"/> Fire pump		Through what type opening <input type="checkbox"/> Y connection to flange and spigot <input type="checkbox"/> Open pipe
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FIGURE 10.10.1 Sample of Contractor's Material and Test Certificate for Underground Piping.

Hydrostatic test	All new underground piping hydrostatically tested at _____ psi for _____ hours		Joints covered <input type="checkbox"/> Yes <input type="checkbox"/> No	
Leakage test	Total amount of leakage measured _____ gallons _____ hours			
	Allowable leakage _____ gallons _____ hours			
Forward flow test of backflow preventer	Forward flow test performed in accordance with 10.10.2.5.2: <input type="checkbox"/> Yes <input type="checkbox"/> No			
Hydrants	Number installed	Type and make	All operate satisfactorily <input type="checkbox"/> Yes <input type="checkbox"/> No	
Control valves	Water control valves left wide open If no, state reason			<input type="checkbox"/> Yes <input type="checkbox"/> No
	Hose threads of fire department connections and hydrants interchangeable with those of fire department answering alarm			<input type="checkbox"/> Yes <input type="checkbox"/> No
Remarks	Date left in service			
Signatures	Name of installing contractor			
	Tests witnessed by			
	For property owner (signed)	Title	Date	
	For installing contractor (signed)	Title	Date	
Additional explanation and notes				
<div style="display: flex; justify-content: space-between;"> © 2012 National Fire Protection Association NFPA 24 (p. 2 of 2) </div>				

FIGURE 10.10.1 *Continued*

SECTION 33 31 13 SITE SANITARY SEWERAGE PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Sanitary sewerage system piping and appurtenances from a point 5 feet outside the building to the point of disposal.
- B. Sanitary sewerage drainage piping, fittings, and accessories.
- C. Connection of building sanitary drainage system to existing on-site.
- D. Cleanout access.

1.02 PRODUCTS INSTALLED BUT NOT FURNISHED UNDER THIS SECTION

- A. Supply of connection devices to building piping for placement by this Section.

1.03 RELATED REQUIREMENTS

- A. Section 31 23 16 - Excavation: Excavating of trenches.
- B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 23 23 - Fill: Bedding and backfilling.
- D. Section 33 05 43 - Corrosion Protection: Reducing exposure of metal parts in sulfate containing soils.

1.04 DEFINITIONS

- A. Bedding: Fill placed under, beside and directly over pipe, prior to subsequent backfill operations.

1.05 REFERENCE STANDARDS

- A. ASTM A536 - Standard Specification for Ductile Iron Castings; 1984, with Editorial Revision (2019).
- B. ASTM C478 - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2019.
- C. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets; 2021.
- D. ASTM C564 - Standard Specification for Rubber Gaskets for Cast Iron Soil Pipe and Fittings; 2020a.
- E. ASTM C891 - Standard Practice for Installation of Underground Precast Concrete Utility Structures; 2020.
- F. ASTM C923 - Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals; 2018.
- G. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- H. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- I. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems; 2020.

- J. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- K. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals; 2007 (Reapproved 2013).
- L. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe; 2014 (Reapproved 2021).
- M. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.
- N. City requirements.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of sewer line with size, location and installation of service utilities.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.07 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Shop Drawings:
 - 1. For pre-cast concrete sanitary manholes, including frames and covers.
 - 2. Coordination profile drawings showing sanitary sewerage system piping in elevation . Draw profiles at a horizontal scale of not less than 1 inch equals 50 feet and vertical scale of not less than 1 inch equals 5 feet. Indicate pipe and underground structures. Show types, sizes, materials, and elevations of other utilities crossing sewerage system piping.
- D. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- E. Field Quality Control Submittals: Document results of field quality control testing.
- F. Project Record Documents:
 - 1. Submit documents under provisions of Section 01 78 00 - Closeout Submittals.
 - 2. Record location of pipe runs, connections, manholes, cleanouts, and invert elevations.
 - 3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.08 REGULATORY REQUIREMENTS

- A. Conform to applicable code for materials and installation of the Work of this section.
- B. Comply with requirements of Local Plumbing Code, Health Department, and Authorities having jurisdiction.
- C. Utility Compliance: Comply with local utility regulations and standards pertaining to sanitary sewerage systems.
- D. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to sanitary sewerage systems.
- E. Permits: Obtain all required permits in name of Owner.

1.09 PROJECT CONDITIONS

- A. Site Information: Perform site survey, research public utility records, and verify existing utility locations. Verify that storm sewerage system piping may be installed in compliance with original design and referenced standards.
 - 1. Locate existing sanitary sewerage system piping and structures that are to be abandoned and closed.

1.10 SEQUENCING AND SCHEDULING

- A. Coordinate connection to public sewer with utility company.
- B. Coordinate with interior building sanitary drainage piping.
- C. Coordinate with other utility work.

PART 2 PRODUCTS

2.01 SEWER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. General: Provide pipe and pipe fitting materials compatible with each other. Where more than one type of materials or products is indicated, selection is Installer's option.
- C. Plastic Pipe: ASTM D3034, Type SDR35, Poly(Vinyl Chloride) (PVC) material; inside nominal diameter of 4 to 8 inches, bell and spigot style solvent sealed joint end.
 - 1. Solvent Cement: ASTM D2564.
 - 2. Gaskets: ASTM F477, elastomeric seal.
 - 3. Pipe Joints: ASTM D3212.
- D. Joint Seals: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal.
- E. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wyes, bends, cleanouts, reducers, traps and other configurations required.

2.02 PIPE ACCESSORIES

- A. Cleanouts: Provide cast-iron ferrule and countersunk brass cleanout plug, with round cast-iron access frame and heavy-duty, secured, scoriated cast-iron cover.
 - 1. Acceptable Manufacturers:
 - a. Ancon, Inc.
 - b. Josam Co.
 - c. Smith (Jay R.) Mfg. Co.
 - d. Wade Div.; Tyler Pipe.
 - e. Zurn Industries, Inc.; Hydromechanics Div.
 - f. Substitutions: See Section 01 60 00 - Product Requirements.
- B. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Sewer Service" in large letters.
- C. Underground Warning Tapes: Polyethylene plastic tape with metallic core, 6 inches wide by 4 mils thick, solid green in color with continuously printed caption in black letters "CAUTION - SEWER LINE BURIED BELOW."
 - 1. Allen Systems, Inc.; Reef Industries, Inc.

2. Brady (W.H.) Co.; Signmark Div.
 3. Calpico, Inc.
 4. Carlton Industries, Inc.
 5. EMED Co., Inc.
 6. Seton Name Plate Co.
- D. Couplings: Rubber or elastomeric compression gasket, made to match pipe inside diameter or hub, and adjoining pipe outside diameter.
1. Gaskets: ASTM C425, rubber for vitrified clay pipe; ASTM C443, rubber for concrete pipe; ASTM C564, rubber for cast-iron soil pipe; and ASTM F477, elastomeric seal for plastic pipe. Gaskets for dissimilar or other pipe materials shall be compatible with pipe materials being jointed.
- E. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required wyes, bends, cleanouts, reducers, traps and other configurations required.
- F. Corrosivity Protection: All underground metallic pipe and fittings shall be protected from corrosive soils by 8 mil minimum polyethylene sheet.

2.03 CLEANOUT MANHOLE

- A. Manholes shall conform to City Standard Drawing and the SSPWC (Greenbook).
- B. Manhole Frames and Covers: ASTM A536, Grade 60-40-18, heavy-duty, ductile iron, 24-inch inside diameter by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch-diameter cover, indented top design, with lettering "SANITARY SEWER" cast into cover.
- C. Pre-cast Concrete Manholes: ASTM C478 pre-cast reinforced concrete, of depth indicated with provision for rubber gasket joints.
1. Base Section: 12-inch minimum thickness for floor slab and 4.125-inch minimum thickness for walls and base riser section, and having a separate base slab or base section with integral floor.
 2. Riser Sections: 4.125-inch minimum thickness; 48-inch diameter, and lengths to provide depth indicated.
 3. Top Section: Eccentric cone type, unless concentric cone or flat-slab-top type is indicated. Top of cone to match grade rings.
 4. Grade Rings: Provide 2 or 3 reinforced concrete rings, of 6 to 9 inches total thickness and match 24-inch diameter frame and cover.
 5. Gaskets: ASTM C443, rubber.
 6. Steps: Cast into base, riser, and top sections sidewall at 12- to 16-inch intervals.
 7. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.
 8. Channel and Bench: Concrete.
- D. Base Pad: Levelled top surface to receive concrete shaft sections, sleeved to receive sanitary sewer pipe sections.
1. Concrete: Ready-mixed, complying with ASTM C94/C94M; Type V - Sulfate Resistant Portland cement; 3,000 psi strength at 28 days, 3 inch slump; 3/4 inch nominal size aggregate.

2.04 BEDDING AND COVER MATERIALS

- A. Pipe Bedding Material: As specified in Division 31 - Earthwork and applicable City or County Standards.
- B. Pipe Cover Material: As specified in Division 31 - Earthwork and applicable City or County Standards.

PART 3 EXECUTION

3.01 GENERAL

- A. Perform work in accordance with applicable code(s).
- B. Comply with Section 33 05 43 - Corrosion Protection.
- C. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground sanitary sewerage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
- D. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements.
- E. Use fittings for branch connections, except where direct tap into existing sewer or manhole is indicated.
- F. Use proper size increasers and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
- G. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
 - 1. Place bell ends of piping facing upstream.
- H. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- I. No pipe shall be laid in water and all costs for drainage and/or dewatering trenches during construction shall be borne by the Contractor.

3.02 TRENCHING

- A. See Division 31 - Earthwork for additional requirements.
- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
 - 1. Correct over excavation in accordance with the Section in Division 31.
 - 2. Remove large stones or other hard matter which could damage pipe or impede consistent backfilling or compaction.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.
- D. If during the installation of pipe, the trench material, backfill material is found to be unsuitable, as determined by the Engineer, it shall be removed and replaced by crushed rock as defined by SSPWC (Greenbook) 200-2.2 or 200-2.3 except that minimum sand equivalent value shall be 30. Any excess material that is generated by this process shall be disposed of by the Contractor at no additional cost to the District.
- E. Bedding:

1. Excavate pipe trench in accordance with the Section in Division 31 for work of this Section. Hand trim excavation for accurate placement of pipe to elevations indicated.
2. Place bedding material at trench bottom, level materials in continuous layer not exceeding 6 inches compacted depth, compact to 95 percent.
3. Maintain optimum moisture content of bedding material to attain required compaction density.

3.03 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Inspect piping before installation to detect apparent defects. Mark defective materials with white paint and promptly remove from site.
- C. Unless specified otherwise, all buried piping shall have coverage of at least three feet between top of pipe and finished grade.

3.04 INSTALLATION - PIPE

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Pipe Applications For Underground Sanitary Sewers
 1. Pipe Sizes 15 inches and Smaller: PVC gasket joint sewer pipe and fittings.
 2. Pipe Sizes 1-1/2 to 10 Inches: Hubless cast-iron soil pipe and fittings.
- C. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 1. Plastic Pipe: Also comply with ASTM D2321.
 2. Pipe shall be assembled by hand or by use of a bar and block or by lever puller. No swinging or stabbing shall be permitted. The "popping-on" of joints is expressly forbidden. All bell and spigot type connection shall be marked on the spigot end to indicate full insertion.
- D. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- E. Connect to building sanitary sewer outlet and municipal sewer system, through installed sleeves.
- F. Install trace wire 6 inches above top of pipe; coordinate with the Section in Division 31 - Earthwork.

3.05 PIPE JOINT CONSTRUCTION AND INSTALLATION

- A. Join and install hubless cast iron soil pipe and fittings, with "Best" or "MG" cast-iron couplings with neoprene gaskets. Stainless steel couplings not acceptable below grade.
- B. Join and install PVC pipe as follows:
 1. Pipe and gasketed fittings, joining with elastomeric seals.
 2. Installation in accordance with ASTM D2321.
- C. Join different types of pipe with standard manufactured couplings and fittings intended for that purpose.

3.06 INSTALLATION MANHOLES

- A. Install manholes complete with accessories as indicated. Form continuous concrete or split pipe section channels and benches between inlets and outlet. Set tops of frames and covers flush with finish surface where manholes occur in pavements. Elsewhere, set tops 3 inches above finish surface, unless otherwise indicated.
- B. Place pre-cast concrete manhole sections as indicated, and install in accordance with ASTM C891.
- C. Provide rubber joint gasket complying with ASTM C443 at joints of sections.
- D. Apply bituminous mastic coating at joints of sections.

3.07 INSTALLATION - CLEANOUTS

- A. Install cleanouts and extension from sewer pipe to cleanout at grade as indicated. Set cleanout frame and cover in concrete block 18 by 18 by 12 inches deep, except where location is in concrete paving. Set top of cleanout 1 inch above surrounding earth grade or flush with grade when installing in paving.
 - 1. Provide as shown on plans and as required by Plumbing Code.
- B. Form bottom of excavation clean and smooth to correct elevation.
- C. Form and place cast-in-place concrete base pad, with provision for sanitary sewer pipe end sections.
- D. Establish elevations and pipe inverts for inlets and outlets as indicated.
- E. Mount lid and frame level in grout, secured to top cone section to elevation indicated.

3.08 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap, with not less than 6 inches of 3000 psi 28-day compressive-strength concrete.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.09 FIELD QUALITY CONTROL

- A. Perform field inspection and testing in accordance with Section 01 40 00.
- B. Perform testing of completed piping in accordance with local authorities having jurisdiction.
- C. Request inspection prior to and immediately after placing bedding.
- D. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 - 2. All sewer mains constructed and to become part of the public sewer system shall be digitally recorded by the City prior to acceptance of the sewer system for maintenance by the City.
 - 3. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.
 - 4. Perform video inspection of all piping prior to final acceptance of work.

- a. All video operations shall be recorded digitally for playback if required.
- b. All video inspections will include a detailed narrative identifying exact locations of the installed lines and limits of areas to be re-installed.
- E. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to District.
- F. Reinspect after any corrections, include video recording.

3.10 CLEANING

- A. Cleaning: Clear interior of piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed.
 - 1. Place plugs in ends of uncompleted pipe at end of day or whenever work stops.
 - 2. Flush piping between manholes, if required by local authority, to remove collected debris.

3.11 PROTECTION

- A. Protect finished installation under provisions of Section 01 50 00 - Temporary Facilities and Controls.
- B. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 41 00 SUBDRAINAGE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Retaining Wall Drainage Systems.
 - 1. Drainage system at vertical waterproofed walls and segmental retaining walls, as complete designed working drainage system channeling water to subdrainage system piping, or to wall face.
 - 2. Geotextile pipe wrap.
 - 3. Subdrainage piping system, complete with necessary couplings and accessories.
- B. Filter aggregate and fabric and bedding.

1.02 RELATED REQUIREMENTS

- A. Section 07 13 00 - Sheet Waterproofing: Below grade waterproofing and protection board.
- B. Section 31 05 19 - Geosynthetics for Earthwork.
- C. Section 31 22 00 - Grading: Excavating, bedding, and backfilling.
- D. Section 31 23 16 - Excavation: Excavating for subdrainage system piping and surrounding filter aggregate.
- E. Section 31 23 16.13 - Trenching: Excavating and backfilling for site subdrainage systems.
- F. Section 31 23 23 - Fill: Backfilling over filter aggregate, up to subgrade elevation.
- G. Section 32 32 23 - Segmental Retaining Walls.

1.03 REFERENCE STANDARDS

- A. ASTM D2729 - Standard Specification for Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2021.

1.04 DEFINITIONS

- A. Geotextile: Any permeable textile used with foundation, soil, rock, earth, or any other geotechnical material, as an integral part of man-made product, structure, or system.
- B. Normal Direction: Direction perpendicular to the plane of a geotextile.
- C. Permittivity: Volumetric flow rate of water per unit cross sectional area per unit head under laminar flow conditions, in the normal direction through a geotextile.
- D. Permeability: Rate of flow of a liquid under a differential pressure through a material.
- E. Transmissivity: Flow or amount of liquid water per foot of material width passing through composite system at certain maximum soil pressure against geotextile at defined hydraulic gradient.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data on pipe drainage products, pipe accessories, and connectors.
- C. Shop Drawings: Indicate dimensions, layout of piping, high and low points of pipe inverts, gradient of slope between corners and intersections, and depths of footings.

- D. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- E. Project Record Documents: Record location of pipe runs, connections, cleanouts and principal invert elevations.

1.06 PRE-INSTALLATION MEETING

- A. Pre-Installation Conference: Include subdrainage system conference with conference scheduled for waterproofing materials.

1.07 SEQUENCING AND SCHEDULING

- A. Schedule subdrainage material installation after waterproofing installation and curing and protection board placement, and just prior to backfilling operations.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable code for materials and installation of the work of this section.

2.02 PIPE MATERIALS

- A. Polyvinyl Chloride Pipe: ASTM D2729; plain end, 4 inch inside diameter; with required fittings.
- B. Use perforated pipe at subdrainage system; unperforated through sleeved walls.
 - 1. Foundation drainage:
 - a. Provide perforated drainage pipe at footings and below grade walls.
 - b. Shop perforate pipe with 1/4 inch minimum to 3/8 inch maximum holes or nominal 1/4 by 4 inch long slots.
 - c. Perforations shall occur within maximum arc of 160 degrees.
 - 2. Drain lines: Provide solid drainage pipe to conduct water from footings and below grade walls, to storm drain lateral, outlet, or curb face as indicated.

2.03 AGGREGATE AND BEDDING

- A. Filter Aggregate and Bedding Material: Granular fill as specified in Section 31 23 23.
- B. Filter Sand and Bedding Material: Sand as specified in Section 31 23 23.
- C. Impervious Fill Material: Type as specified in Section 31 23 23.

2.04 ACCESSORIES

- A. Pipe Couplings: Solid plastic.
- B. Joint Covers: 10 mil thick polyethylene.
- C. Filter Fabric: Water pervious type, black polyolefin.
- D. Furring strips: Pressure treated lumber specified in Rough Carpentry section.
- E. Sleeve: Unperforated PVC type for foundation wall.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. Verification of Conditions: Verify that waterproofing protection board is in place, if specified in applicable waterproofing Section. Verify one percent minimum slope to underslab collection pipes.
- C. Substrate: Examine substrates to determine suitability in accordance with manufacturer's instructions and recommendations. Correct all deficiencies before proceeding with subdrainage system installation.

3.02 PREPARATION

- A. Excavate trenches to lines and grades required for pipe positions and slopes to drain.
- B. Hand trim excavations to required elevations. Correct over-excavation with bedding aggregate.
- C. Remove large stones or other hard matter that could damage drainage piping or impede consistent backfilling or compaction.
- D. Bedding: Place bedding aggregate to depths and arrangements shown on Drawings, taking care to provide uniform and solid bearing for full length of each pipe segment.

3.03 INSTALLATION

- A. Install and join pipe and pipe fittings in accordance with pipe manufacturer's instructions.
 - 1. Form piping into a continuous system, using such fittings and accessories as are recommended by manufacturer of pipe or tile materials, starting at highest required drainage elevation and continuing to point of approved discharge.
- B. At Segmental Retaining Walls:
 - 1. Toe Drain:
 - a. Locate toe drain pipes at the back of the wall rock behind the wall as close to the bottom of the wall as allowed while still maintaining a positive gradient for drainage to daylight, or a storm water management system. Toe drains are installed for incidental water management not as a primary drainage system.
 - 1) For site configurations with bottoms of the base on a level plane provide a minimum one percent gradient be maintained on the placement of the pipe with outlets on 50 ft (15 m) centers, or 100 ft (30 m) centers if pipe is crowned between the outlets. Provide for a maximum height above the bottom of the base in a flat configuration of no more than 6 in. (150 mm).
 - 2) For rigid drain pipes with drain holes the pipes should be positioned with the holes located down. Verify with geotechnical engineer on-site that toe drain pipes be wrapped when installed into base rock complying with the specified wall rock material.
 - 3) Route pipes to storm drains where appropriate or through or under the wall at low points when the job site grading and site layout allows for routing. Prevent pipes from being crushed, plugged, or infested with rodents.
 - 4) Where the natural drop in grade exceeds the one percent minimum, place drain pipes outlets on 100 foot (30 m) centers, maximum.

- 5) When the drain pipe must be raised to accommodate outlets through the wall face, refer to segmental wall manufacturer details.
2. Heel Drain:
 - a. Place the heel drain as indicated on drawings to pick up any water that migrates from behind the retaining wall structure at the cut and route the water away from the reinforced mass during the construction process and for incidental water for the life of the structure.
 - 1) Install piping used at the back of the reinforced mass with a one percent minimum gradient over the length, but it is not critical for it to be positioned at the very bottom of the cut.
 - (a) Vent the heel drain at 100ft (30m) intervals along the entire length of the wall and do not be tied into the toe drain.
 - 2) Provide a rigid pipe with holes at the bottom with an integral sock encasing the pipe, to filter out fines when required based on soil conditions.
 - (a) For infill soils with a high percentage of sand and/or gravel the heel drain pipe does not need to be surrounded by wall rock.
 - (b) With soils containing fine grained cohesive soils having a PI of greater than 6 and LL of 30 or greater, 1 cubic foot (0.03 cubic meter) of drainage rock is required around the pipe for each 1 ft. (30 cm) of pipe length.
- C. Place drainage pipe on clean cut subsoil.
- D. Lay pipe to slope gradients noted on drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
- E. Loosely butt pipe ends. Place joint cover strip 12 inches wide, around pipe diameter centered over joint.
- F. Take care to prevent potential blockage of system through inadvertent soil or debris intrusions.
- G. Place pipe with perforations facing down. Mechanically join pipe ends.
- H. Install pipe couplings.
- I. Install filter aggregate at sides, over joint covers and top of pipe. Provide top cover compacted thickness of 12 inches.
- J. Provide cleanouts to grade at ends of each run for system cleaning and checking.
- K. Place filter fabric over levelled top surface of aggregate cover prior to subsequent backfilling operations.
 1. Install geotextile as detailed on Drawings in "taco" fashion, as referred to in construction trade, with sides brought together and attached to wall with wood furring strip. Lap end joints of geotextile fabric in accordance with manufacturer's installation instructions.
- L. Place aggregate in maximum 4 inch lifts, consolidating each lift.
 1. Install aggregate backfill shown on Drawings and in accordance with Section 31 23 16.13 - Trenching, taking care to prevent crushing of pipe.
 2. Provide protection over subdrainage piping until placement of next succeeding layer or increment of construction.
- M. Refer to Section 31 23 23 for compaction requirements. Do not displace or damage pipe when compacting.
- N. Place impervious fill over drainage pipe aggregate cover and compact.
- O. Connect to storm drain system with unperforated pipe, through installed sleeves.
- P. Coordinate the Work with connection to on site storm drain system, and trenching.

3.04 FIELD QUALITY CONTROL

- A. Section 01 40 00 - Quality Requirements: Field inspection and testing.
- B. Request inspection prior to and immediately after placing aggregate cover over pipe.

3.05 PROTECTION

- A. Protect pipe and aggregate cover from damage or displacement until backfilling operation begins.

END OF SECTION

SECTION 33 42 11 STORMWATER GRAVITY PIPING

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Stormwater drainage piping.
- B. Stormwater pipe accessories.

1.02 RELATED REQUIREMENTS

- A. Section 31 23 16 - Excavation: Excavating of trenches.
- B. Section 31 23 16.13 - Trenching: Excavating, bedding, and backfilling.
- C. Section 31 23 23 - Fill: Bedding and backfilling.
- D. Section 33 42 30 - Stormwater Drains.

1.03 REFERENCE STANDARDS

- A. AASHTO M 252 - Standard Specification for Corrugated Polyethylene Drainage Pipe; 2023.
- B. AASHTO M 294 - Standard Specification for Corrugated Polyethylene Pipe, 300- to 1500-mm (12- to 60-in.) Diameter; 2021.
- C. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications; 2020.
- D. ASTM D3034 - Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings; 2023.
- E. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials; 2021.
- F. SSPWC (Greenbook) - Standard Specifications for Public Works Construction; Current Adopted Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate the installation of stormwater gravity piping with size, location and installation of stormwater drains according to Section 33 42 30.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide data indicating pipe, pipe accessories.
- C. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- D. Manufacturer's Installation Instructions: Indicate special procedures required to install Products specified.
- E. Field Quality Control Submittals: Document results of field quality control testing.
- F. Project Record Documents:
 - 1. Submit documents under provisions of Section 01 78 00 - Closeout Submittals.

2. Record location of pipe runs, connections, and invert elevations.
3. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

PART 2 PRODUCTS

2.01 REGULATORY REQUIREMENTS

- A. Comply with applicable code for materials and installation of the Work of this section.
 1. Conform to requirements of California Plumbing Code and Authorities Having Jurisdiction.
- B. Utility Compliance: Comply with local utility regulations and standards pertaining to storm drainage systems.
- C. Environmental Compliance: Comply with applicable portions of local environmental agency regulations pertaining to storm drainage systems.

2.02 STORMWATER PIPE MATERIALS

- A. Provide products that comply with applicable code(s).
- B. Plastic Pipe: ASTM D3034, Type PSM, Poly Vinyl Chloride (PVC) material; inside nominal diameter of 4 to 15 inches, bell and spigot style solvent sealed joint end.
 1. SDR 35, unless indicated otherwise on Drawings.
- C. Plastic Pipe: ASTM D3350, High Density Polyethylene (HDPE) corrugated wall pipe with integrally formed smooth liner; inside nominal diameter of 4 inch, meeting the requirements of AASHTO M 252, Type S, for diameters between 3 inches and 10 inches and AASHTO M 294, Type S, for diameters between 12 inches and 60 inches, soil-tight, bell and spigot joints with rubber gaskets, with pipe and fittings manufactured from virgin PE compounds with cell classification 3254420C.
 1. Basis of Design Product: N-12 as manufactured by ADS, or approved equal.

2.03 PIPE ACCESSORIES

- A. Pipe Joints: Mechanical clamp ring type, stainless steel expanding and contracting sleeve, neoprene ribbed gasket for positive seal, Water Tight.
- B. Fittings: Same material as pipe molded or formed to suit pipe size and end design, in required tee, bends, elbows, cleanouts, reducers, traps and other configurations required.
- C. Filter Fabric: Non-biodegradable, non-woven , AASHTO M288 Class 2. Provide Geosynthetics 315ST manufactured by ADS Advanced Drainage Systems, Inc.; www.ads-pipe.com .
- D. Trace Wire: Magnetic detectable conductor, clear plastic covering, imprinted with "Storm Drain" in large letters.

2.04 BEDDING AND COVER MATERIALS

- A. Bedding: As specified in Section 31 23 16.13.
- B. Cover: As specified in Section 31 23 16.13.

PART 3 EXECUTION

3.01 TRENCHING

- A. See Section 31 23 16.13 - Trenching for additional requirements.

- B. Hand trim excavation for accurate placement of pipe to elevations indicated.
- C. Backfill around sides and to top of pipe with cover fill, tamp in place and compact, then complete backfilling.

3.02 CLOSING ABANDONED STORM DRAINAGE SYSTEM

- A. Abandoned Piping: Close open ends of abandoned underground piping that is indicated to remain in place. Provide sufficiently strong closures to withstand hydrostatic or earth pressure that may result after ends of abandoned utilities have been closed.
 - 1. Close open ends of concrete or masonry utilities with not less than 8 inch thick brick masonry bulkheads.
 - 2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Wood plugs are not acceptable.
- B. Abandoned Structures: Remove structure and close open ends of the remaining piping, or remove top of structure down to not less than 3 feet below final grade; fill structure with stone, rubble, gravel, or compacted dirt, to within 1 foot of top of structure remaining and fill concrete.

3.03 INSTALLATION

- A. Verify that trench cut is ready to receive work and excavations, dimensions, and elevations are as indicated on layout drawings.
- B. General Locations and Arrangements: Drawings (plans and details) indicate the general location and arrangement of the underground drainage system piping. Location and arrangement of piping layout take into account many design considerations. Install the piping as indicated, to the extent practical.
 - 1. Install in accordance with SSPWC (Greenbook), local standards and soils report.
 - 2. Install pipe, fittings and accessories in accordance with ASTM D3034 and manufacturer's instructions. Seal joints watertight.
- C. Install pipe, fittings, and accessories in accordance with manufacturer's instructions. Seal watertight.
 - 1. Plastic Pipe: Also comply with ASTM D2321.
- D. Lay pipe to slope gradients noted on layout drawings; with maximum variation from true slope of 1/8 inch in 10 feet.
 - 1. Install piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings in accordance with manufacturer's recommendations for use of lubricants, cements, and other installation requirements.
 - 2. Use fittings for branch connections, except where direct tap into existing sewer or manhole is indicated.
 - 3. Use proper size increasers and couplings, where different size or material of pipes and fittings are connected. Reduction of the size of piping in the direction of flow is prohibited.
 - 4. Install piping pitched down in direction of flow, at minimum slope of 2 percent, except where indicated otherwise.
 - a. Place bell ends of piping facing upstream.

- 5. Tunneling: Install pipe under streets or other obstructions that cannot be disturbed, by tunneling, jacking, or a combination of both.
- E. Connect to building storm drainage system, foundation drainage system, and utility/municipal system.
- F. Make connections through walls through sleeved openings, where provided.
- G. Install continuous trace wire 6 inches above top of pipe; coordinate with Section 31 23 16.13.

3.04 TAP CONNECTIONS

- A. Make connections to existing piping and underground structures so that finished work will conform as nearly as practicable to the requirements specified for new work.
- B. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6 inch overlap, with not less than 6 inches of 3000 psi 28-day compressive-strength concrete.
- C. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris, concrete, or other extraneous material that may accumulate.

3.05 FIELD QUALITY CONTROL

- A. Perform field inspection in accordance with Section 01 40 00 - Quality Requirements.
 - 1. Perform testing of completed site piping in accordance with the Plumbing Code using water or air pressure test.
- B. Interior Inspection: Inspect piping to determine whether line displacement or other damage has occurred.
 - 1. Make inspections after pipe between manholes and manhole locations has been installed and approximately 2 feet of backfill is in place, and again at completion of project.
 - 2. If inspection indicates poor alignment, debris, displaced pipe, infiltration or other defects correct such defects, and reinspect.
 - 3. Perform video inspection of all piping prior to final acceptance of work.
 - a. All video operations shall be recorded digitally for playback if required.
 - b. All video inspections will include a detailed narrative identifying exact locations of the installed lines and limits of areas to be re-installed.
- C. If tests indicate Work does not meet specified requirements, remove Work, replace and retest at no cost to District.
- D. Reinspect after any corrections, include video recording.

3.06 PROTECTION

- A. Protect pipe and bedding cover from damage or displacement until backfilling operation is in progress.

END OF SECTION

SECTION 33 42 30 STORMWATER DRAINS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Precast concrete catch basins.
- B. Cast-in-place concrete catch basins.
- C. Cast-in-place concrete base pad.
- D. Prefabricated trench drains.
- E. Frames and grates.

1.02 RELATED REQUIREMENTS

- A. Section 03 30 00 - Cast-in-Place Concrete.
- B. Section 31 23 16 - Excavation.
- C. Section 31 23 23 - Fill.
- D. Section 33 42 11 - Stormwater Gravity Piping.

1.03 REFERENCE STANDARDS

- A. AASHTO HB - Standard Specifications for Highway Bridges; 2005, with Errata.
- B. ACI CODE-318 - Building Code Requirements for Structural Concrete and Commentary; 2019 (Reapproved 2022).
- C. ACI PRC-211.1 - Selecting Proportions for Normal-Density and High Density-Concrete - Guide; 2022.
- D. ACI PRC-304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete; 2000 (Reapproved 2009).
- E. ACI PRC-305 - Guide to Hot Weather Concreting; 2020.
- F. ACI PRC-306 - Guide to Cold Weather Concreting; 2016.
- G. ACI SPEC-301 - Specifications for Concrete Construction; 2020.
- H. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2023.
- I. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2024.
- J. ASTM C150/C150M - Standard Specification for Portland Cement; 2022.
- K. ASTM C478/C478M - Standard Specification for Circular Precast Reinforced Concrete Manhole Sections; 2020.
- L. ASTM C990 - Standard Specification for Joints for Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants; 2009 (Reapproved 2019).
- M. ASTM G154 - Standard Practice for Operating Fluorescent Ultraviolet (UV) Lamp Apparatus for Exposure of Nonmetallic Materials; 2023.
- N. CBC Ch. 11B - California Building Code-Chapter 11B; Current adopted edition.
- O. EPA (NPDES) - National Pollutant Discharge Elimination System (NPDES), Construction General Permit; Current Edition.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Installation of stormwater drains with piping and other structures.
 - 1. See Section 33 42 11 for stormwater gravity piping.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by affected installers.
- C. Sequencing: Ensure that utility connections are achieved in an orderly and expeditious manner.

1.05 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements for submittal procedures.
- B. Product Data: Weight rating for catch basins and frame and grates.
- C. Shop Drawings: Indicate stack assembly, invert elevations, opening sizes, and pipe angles.
- D. Manufacturer's Installation Instructions: Indicate special procedures for assembly.
- E. Manufacturer's qualification statement.
- F. Installer's qualification statement.
- G. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- H. Field Quality Control Submittals: Document results of field quality control testing.
- I. Project Record Documents:
 - 1. Record invert elevations of catch basins and trench drains.
 - 2. Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with at least three years of documented experience.
- B. Installer Qualifications: Company specializing in installing work of the type specified in this section, and with at least three years of documented experience.
- C. Documents at Project Site: Maintain one copy of manufacturer's instructions, assembly drawings, and shop drawings at the project site.
- D. Perform work of this section in accordance with ACI SPEC-301 and ACI CODE-318.
 - 1. Maintain one copy of each document on site.
- E. Follow recommendations of ACI PRC-305 when concreting during hot weather.
- F. Follow recommendations of ACI PRC-306 when concreting during cold weather.

PART 2 PRODUCTS

2.01 CATCH BASINS

- A. Weight Rating: H 20 according to AASHTO HB.
- B. Precast Concrete Catch Basins: Comply with ASTM C478/C478M, reinforced.
 - 1. Wall Thickness: Manufacturer's standard.
 - 2. Precast Base Thickness: 2 inches Manufacturer's standard.
 - 3. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.

4. Joint Sealant: Comply with ASTM C990.
5. Manufacturers:
 - a. Brooks Products; XXXX CB Series: www.brooksproductsnw.com.
 - b. J&R Concrete Products; CBXXXX Series: www.jrconcreteproducts.com.
 - c. Substitutions: See Section 01 60 00 - Product Requirements.
- C. Cast-In-Place Concrete Catch Basins: Comply with ASTM C94/C94M, reinforced.
 1. Wall Thickness: 6 inches (152 mm).
- D. Cast-In-Place Concrete Base Pads: Comply with ASTM C94/C94M, reinforced.
 1. Thickness: 12 inches.
 2. Width: Match outside catch basin diameter.
 3. Length: Match outside catch basin diameter.
- E. Cast-In-Place Concrete Materials:
 1. Cement: ASTM C150/C150M, Type II.
 2. Sand: ASTM C33/C33M, fine aggregate.
 3. Crushed Gravel: ASTM C33/C33M, coarse aggregate.
 4. Reinforcement: Formed steel wire, galvanized finish, wire diameter as indicated on drawings.
 5. Water: Potable.
 6. Form Materials: Wood, profiled to suit conditions.
- F. Frames and Grates: Cast iron, pattern as indicated.

2.02 CATCH BASIN, TRENCH DRAIN, CLEANOUT, AND AREA DRAIN COMPONENTS

- A. Lids and Drain Covers: Cast iron, hinged to cast iron frame, lockable and extra heavy duty proof load.
 1. At pedestrian areas provide ADA Standards and CBC Ch. 11B compliant grates with maximum 1/2 inch wide openings. Place linear openings perpendicular to path of travel.
 2. Catch Basin:
 - a. Lid Design: Linear grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings
 3. Cleanout:
 - a. Lid Design: Checkerboard grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings
 4. Area Drain:
 - a. Lid Design: Linear grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings
 5. Trench Drain:
 - a. Lid Design: Linear grill.
 - b. Nominal Lid and Frame Size: As indicated on Drawings
 6. Landscape Drain:
 - a. Lid Design: As indicated on Drawings.
 - b. Nominal Lid and Frame Size: As indicated on Drawings.

- c. Atrium Grate: Raised dome type, HDPE or Polyethylene with UV inhibitor.
 - 1) Manufacturers:
 - (a) ADS; Atrium Grate: www.adspipe.com.
 - (b) Brooks Products; Atrium Grate: www.brooksproductsnw.com.
 - (c) NDS Products; Atrium Grate: www.ndspro.com.
 - (d) Substitutions: See Section 01 60 00 - Product Requirements.

2.03 PREFABRICATED TRENCH DRAINS

- A. Prefabricated Trench Drain: Polymer concrete, metal installation brackets.
 - 1. Weight Rating: H 15 according to AASHTO HB.
 - 2. Bottom: Sloped.
 - 3. Ultraviolet Exposure: 10 years minimum, ASTM G154.
 - 4. Frames and Grates: Galvanized steel support, galvanized steel grate, linear pattern, match drain opening size.
 - a. At pedestrian areas provide ADA Standards and CBC Ch. 11B compliant grates with maximum 1/2 inch wide openings. Place linear openings perpendicular to path of travel.
 - 5. Products:
 - a. Basis of Design: ACO Polymer Products, Inc., See Civil Drawings.
 - b. Substitutions: See Section 01 60 00 - Product Requirements.

2.04 ACCESSORIES

- A. Sediment Filter: Provide sediment filter compliant with BMP practice for EPA (NPDES) II, as indicated on Drawings.
 - 1. Product: Storm Water Sediment Control Grate Insert manufactured by Transpo Industries, Inc.: www.transpo.com
- B. Geotextile Filter Fabric:
 - 1. Non-biodegradable, non-woven, AASHTO M 288, Class 2.
 - 2. Provide Geosynthetics 601T manufactured by ADS Advanced Drainage Systems, Inc.; www.ads-pipe.com., or equal.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify items provided by other sections of work are properly sized and located.
- B. Verify built-in items are in proper location and ready for roughing into work.
- C. Verify excavation location and depth are correct.

3.02 EXCAVATION AND FILL

- A. Hand trim excavation for accurate placement to indicated elevations.
- B. Backfill with cover fill, tamp in place and compact, then complete backfilling.
- C. Cover weep holes with 3/4 inch (19 mm) crushed stone.
- D. See Section 31 23 16 for additional excavation requirements.
- E. See Section 31 23 23 for additional fill requirements.

3.03 INSTALLATION

- A. Establish elevations and pipe inverts for inlets and outlets as indicated in drawings.
- B. Concrete Mixing:
 - 1. Proportioning Normal Weight Concrete: Comply with ACI PRC-211.1 recommendations.
 - 2. Admixtures: Add acceptable admixtures as recommended in ACI PRC-211.1 and at rates recommended by manufacturer.
- C. Precast Concrete Catch Basins:
 - 1. Place base section plumb and level.
 - 2. Install joint sealant uniformly around section lip.
 - 3. Overlay additional sections on joint sealant.
 - 4. Install cone or lid plumb and level on joint sealant.
- D. Cast-In-Place Concrete Base Pad:
 - 1. Form base pad according to Section 03 30 00.
 - 2. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
 - 3. Place concrete in accordance with ACI PRC-304.
 - 4. Float base pad top surface level.
- E. Cast-In-Place Concrete Catch Basins:
 - 1. Form catch basin according to Section 03 30 00.
 - 2. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
 - 3. Install reinforcement in maximum lengths. Offset end laps in both directions. Splice laps with tie wire.
 - 4. Place concrete in accordance with ACI PRC-304.
 - 5. Float catch basin top surface level.
- F. Prefabricated Drop Inlets or Trench Drains:
 - 1. Place base section plumb and level.
 - 2. Install according to manufacturer's instructions.
 - 3. Secure installation brackets.
- G. Grade Adjustments:
 - 1. Place adjacent materials tight and smooth following design grades.
- H. Frames and Grates:
 - 1. Place frame plumb and level.
 - 2. Mount frame on prefabricated drop inlets or trench drains according to manufacturer's instructions.
 - 3. Place grate in frame securely.

3.04 FIELD QUALITY CONTROL

- A. See Section 01 40 00 - Quality Requirements for additional requirements.
- B. Perform field inspection for pipe invert elevations.

- C. If inspections indicate work does not meet specified requirements, adjust work and reinspect at no cost to District.

END OF SECTION